1990

Annual Report of the Clemson Board of Trustees, 1989-1990

Clemson University, Board of Trustees

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This was a year of endings and new beginnings in the remarkable story that is Clemson University. Our celebration on November 27, 1989, was one of those once-in-a-lifetime events, and I was very privileged to be part of this great day for Clemson. On that date, the University officially became 100 years old. It had been a century to the day since the state officially accepted the terms and conditions of Thomas Green Clemson’s bequest, an act which gave life to Clemson University.

It also marked the end of our 20-month Centennial and, most importantly, the beginning of the University’s Second Century. Fortified by many good memories of our Centennial, we concluded the final chapter of a story of which every South Carolinian can be proud—a century of service and achievement in education. The history of Clemson is a remarkable success story when we consider the college’s humble beginnings and the tremendous center of excellence it has become today.

No wonder that we embark on the next 100 years with so much expectation and excitement about what the future holds for Clemson.

We could think of no more appropriate way to start our second century than by a renewal of our fundamental commitment to academic excellence. We unveiled to the public The Campaign for Clemson: A Partnership for Academic Excellence. At this writing, we have reached 87 percent of the campaign goal of $62 million.

During the past year we also took a major step to strengthen our competitive position in today’s arena where issues demand national and global capabilities. The University created a Strategic Planning Committee to identify those issues and areas where Clemson can set the pace and achieve national prominence.

The strategic planning effort is a natural outgrowth of our Second Century Plan with its six emphasis areas of Undergraduate Education, Agriculture, Engineering and Basic Science, Marketing and Management, Quality of Life and Textiles.

The strategic plan complements the Second Century Plan by a process designed to further refine and narrow the focus of those previous studies. The four focus areas of the strategic plan are undergraduate education, advanced composite materials, biotechnology for agricultural and environmental applications, and the environment, specifically groundwater protection and restoration.

Focusing on these specific priorities will favorably position Clemson to use its comparative strengths and advantages to become a national leader. This plan has been adopted by the University administration and has been made a part of the total University planning process.

The future is exciting, and in the pages that follow, you will find detailed information about our activities in the past year and an idea of things to come.
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ADMINISTRATIVE OFFICERS

Executive
Max Lennon, Ph.D. ........................................... President
W. David Maxwell, Ph.D. .................................... Provost and Vice President for
Academic Affairs
Hugh J. Clausen, J.D. ........................................ Vice President for Administration
and Secretary of the Board of Trustees
Milton B. Wise, Ph.D. ........................................ Vice President and Vice Provost for Agriculture
and Natural Resources
David R. Larson, MBA ...................................... Vice President for Business and Finance
Gary A. Ransdell, Ph.D. ................................. Vice President for Institutional
Advancement
Jay Gogue, Ph.D. ........................................... Vice President of Research
Manning N. Lomax, B.S. .................................. Vice President for Student Affairs
and Dean of Students

Academic
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Milton B. Wise, Ph.D. ....................................... Vice President and Vice Provost for Agriculture and Natural Resources
Jerome V. Reel, Jr., Ph.D. ................................. Vice Provost and Dean of Undergraduate Studies
Farrell B. Brown, Ph.D. .................................... Acting Vice Provost and Dean of the Graduate School
Christopher J. Duckenfield, Ph.D. ...................... Vice Provost for Computer and Information Technology
Joseph F. Boykin, Jr., M.S. ............................... Director of Libraries
Horace W. Fleming, Ph.D. ............................... Director of the Strom Thurmond Institute for Government and Public Affairs
T. Ross Wilkinson, Ph.D. ................................. Dean and Director of Resident Instruction
James R. Fischer, Ph.D. .................................... Dean, Agriculture Research and Director, S.C. Agricultural Experiment Station
Byron K. Webb, Ph.D. ..................................... Dean and Director, Cooperative Extension Service
James F. Barker, M.A. ..................................... Dean, College of Architecture
Ryan C. Amacher, Ph.D. .................................. Dean, College of Commerce and Industry
Gordon W. Gray Ed.D. ..................................... Dean, College of Education
J. Charles Jennett, Ph.D. ................................. Dean, College of Engineering
Benton H. Box, D.F. ........................................ Dean, College of Forest and Recreation Resources
Robert A. Waller, Ph.D. .................................... Dean, College of Liberal Arts
Opal Hipps, Ph.D. ........................................... Dean, College of Nursing
Bobby G. Wixson, Ph.D. .................................. Dean, College of Sciences

Admissions and Registration
B.J. Skelton, Ph.D. ......................................... Assistant Vice President for Student Affairs and Dean of Admissions and Registration
1989-90 UNIVERSITY BOARD OF TRUSTEES

Louis P. Batson, Jr., Chairman ................................................................. Greenville
Bill L. Amick, Vice Chairman ............................................................... Batesburg
J. J. Britton ......................................................................................... Sumter
Fletcher C. Derrick, Jr. ....................................................................... Charleston
W. G. DesChamps .............................................................................. Bishopville
Lawrence M. Gressette, Jr.* ................................................................. Columbia
Louis B. Lynn ..................................................................................... Columbia
Thomas B. McTeer, Jr. ...................................................................... Columbia
Buck Mickel ....................................................................................... Greenville
Philip H. Prince* ............................................................................... Pawleys Island
B. Marion Smith** ............................................................................ Columbia
Allen P. Wood .................................................................................. Florence

Trustees Emeriti
William N. Geiger, Jr. ........................................................................ Columbia
Paul W. McAlister* ........................................................................... Laurens
Paul Quattlebaum, Jr. ....................................................................... Charleston
James C. Self* .................................................................................. Greenwood
D. Leslie Tindal ................................................................................ Pinewood
James M. Waddell, Jr.* ................................................................... Beaufort

* McAlister, Self and Waddell resigned as active members of the Board effective November 21, 1989, at which time Gressette and Prince joined the board.

** Deceased, October 16, 1989.
CURRENT FUND REVENUES AND EXPENDITURES 
FOR THE YEAR ENDED JUNE 30, 1990

Current Fund Revenues

- Other 5.2%
- State Appropriations 44.3%
- Federal Appropriations 4.5%
- Student Fees 17.4%
- Federal Appropriations 4.5%
- Gifts, Grants and Contracts 11.6%
- Federal Appropriations 4.5%
- Federal Appropriations 4.5%
- Federal Appropriations 4.5%
- Federal Appropriations 4.5%
- Federal Appropriations 4.5%
- Federal Appropriations 4.5%

Current Fund Expenditures

- Bond Debt & Mandatory Transfers 1.3%
- Instruction 26.2%
- Institutional Support 6.3%
- Instruction 26.2%
- Student Services 2.5%
- Public Service 15.2%
- Instruction 26.2%
- Instruction 26.2%
- Instruction 26.2%
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- Instruction 26.2%
COLLEGE OF AGRICULTURAL SCIENCES

The report of 1989-90 activities for the College of Agricultural Sciences' resident instruction, research and Extension programs is included under the Division of Agriculture and Natural Resources on page 75.

COLLEGE OF ARCHITECTURE

Strategic planning continues to give direction to the College of Architecture. The environment of challenge and change in higher education and in the professions demands a dynamic planning process for the college. This process has produced programs, faculty and students who are not just responding to change, but actually making change.

In August 1989, Architecture, the professional journal in the field, published a critical review of Clemson's College of Architecture with the following assessment:

Imagine a school in balance: where a strong tradition coexists with innovation, where the campuses are both small-town and urban, where faculty and students share mutual respect, where architectural education is valued but considerate of the total development of the individual, where a strong sense of identity frees faculty and students to explore, where student work ranges from traditional solutions to spiritual pilgrimage. Would such a school be an architectural Eden? Visit Clemson University and see.

This eight-page review provides the faculty, staff and students with confidence that their efforts are being recognized and encouragement to strive for greater achievements. The highlights of these achievements from 1989-90 include:

- Professor George Means was recognized as a national ACSA Distinguished Professor for his work in the specialty of architecture for health. Professor Means joins Professors Harlan McClure, Harold Cooledg and Peter Lee in this national honor, giving Clemson more national Distinguished Professors than any college of architecture in North America.
- Professor Roger Liska was awarded the highest teaching award in the field of building science with the W. A. Klinger Construction Educators Award.
- Professors David Egan and Peter Lee were named in the national American Institute of Architects Education Honor Awards for their innovative teaching in architectural acoustics.

These three national awards demonstrate the faculty's continuing commitment to teaching and serve as a standard for new faculty beginning their teaching career. Innovative teaching remains the college's highest priority.

- Professor Yuji Kishimoto was given a special award by S.C. Governor Carroll Campbell for his service in support of economic development. Professor
Kishimoto has been successful in building programs with Japanese companies and investors.

- Associate Dean Gayland Witherspoon was elected to represent the South Atlantic Region on the national American Institute of Architects Board of Directors.
- The Department of Planning Studies (Professor Herbert Norman) was awarded a $410,000 grant from the federal office of Housing and Urban Development (HUD) in support of 17 students in programs of work study for 1989-91.
- All five faculty in the Department of Planning Studies were asked to present papers at the 1989 Association of Collegiate Schools of Planning Conference in Portland, Oreg.
- Funded research in the Department of Building Science topped $100,000 in awards in 1989-90. In addition, the department, in partnership with the Association of Builders and Contractors (ABC), offered 13 academies for the year. To date, more than 500 individuals, representing 240 companies throughout the United States, have participated in these continuing education academies. This represents a $500,000 investment by ABC and these construction companies.
- The college's four new degree programs continued their growth in student enrollment and quality. The new Bachelor of Fine Arts and Bachelor of Landscape Architecture programs are attracting students who meet the highest admission standards at Clemson University. Each program adds 15-20 students per year. The Master of Science in Architecture and Master of Building Science and Management programs show increases in applications and admissions.
- In a unique partnership between Clemson University's Office of Facilities Maintenance and Operations and the College of Architecture, a computer model of the Clemson University campus is being developed. Supported by the University Innovation Fund and the architectural firm of Skidmore, Owings and Merrill, this campus computer model program has state-of-the-art equipment and software. The University community sees this computer model as a tool in development, inventory, research and master planning. Under the direction of Robert Lowry, the model has already proven to be a genuine asset in decision making regarding campus building design and location, and it has provided graduate students with a special learning opportunity as they help develop this computer model.
- The Clemson Architectural Foundation's Harlan E. McClure Endowment, a component of The Campaign for Clemson, has topped $1 million in cash and pledges. The endowment honors Dean Emeritus McClure by securing the future of programs he established and the development of new innovative programs in support of the College of Architecture. A significant gift to the McClure Endowment was received from the Daniel Foundation. This $220,000 gift in support of the programs and facilities of the Charles E. Daniel Center in Genoa, Italy, will be matched by $320,000 to build an endowment for the future of the Daniel Center, totaling $540,000.
In an environment of challenge and change, creativity is the single greatest asset of the College of Architecture. Creativity has long been seen as "the stock in trade" for faculty and students in the college, and the future will demand the finest creative thinking to address space needs, faculty development and the changes affecting the professions.

Special Programs

The Clemson Architectural Foundation Lecture Series, supported by donations to the Clemson Architectural Foundation, sponsored the following speakers for the academic year 1989-90:

September 18 ... John M. Bryan ................. "Robert Mills: Designs for Democracy"
October 2 .......... Daniel Libeskind ............ "Recent Works"
October 16 ...... John J. McLaughlin .......... "Jefferson's Monticello"
November 13 .... Malcolm Quantrill ............ "In the Landscape of Innocence and Experience: Thingness and Otherness in the Suburbs"
November 20 .... Anatole Senkevitch, Jr....... "Soviet Avant Garde Architecture in the Twenties and Its Current Echoes"
February 20 ..... Thom Mayne .................. "Morphosis: Recent Works"
March 5 ..................... Merrill Elam "Scogin, Elam & Bray: Recent Works"
March 26 ......... Charles R. Mack ............. "An Architectural Look at Thermal Spas in Renaissance Italy"
March 28 .......... June Thomas .................. Honors & Awards Day Speaker
April 9 .......... Walter Chatham ................ "Ten Buildings"

The Rudolph E. Lee Gallery, Clemson University's art gallery, featured the following exhibitions last year:

September 4 - 29 .................... Ke Francis: Installations, Paintings, Sculpture, Prints
September 27 - November 15 ... Nobu Uchii: Contemporary Tapestries in Cooper Library
October 7 - 29 ...................... Steve Poleskie, Art Flyer: Prints, Drawings, Photos
November 6 - 26 .................. Three-Person Show: Michael Aurbach, Jim Buonaccorsi, Gina Gilmour
December 2 - 15 .................. MFA Thesis Exhibition
January 17 - February 16 ....... Berlin Architecture
February 26 - March 29 ............ Africoba
March 16 .................................. Architect’s Day
April 2 - 12 ............................... MFA Thesis Exhibition/Architectural Thesis Projects
April 16 - 20 ............................. Architectural Thesis Projects
April 20 - 27 ............................. Elements of the Environment: Elements of Architecture

Department of Architectural Studies

The department admitted its first students into the newly approved Master of Science in Architecture degree program. Undergraduate faculty finalized a four-year transition to major curriculum revisions and initiated significant changes to the course content of all undergraduate design studios.

Significant Faculty Accomplishments

- Professor Joseph L. Young, FAIA, announced his retirement following 40 years of service to the University.
- Professor Ken Russo, AIA, announced his retirement following 27 years of service to the University.
- Professor George C. Means, FAIA, received the ACSA Distinguished Professor Award at the Annual Convention in San Francisco.
- Professor Richard Norman’s, AIA, book, Electronic Color, was published by Van Nostrand Reinhold.
- Alumni Professor Peter Lee, AIA, and Professor M. David Egan received the ACSA Education Award for Innovative Teaching for their work with architectural acoustics.
- Professor Martin Davis, AIA, completed an 18-month study of advanced curricula in energy design funded by the South Carolina Division of Energy, Agriculture and Natural Resources.
- Professor Lynn Craig, AIA, RIBA, was elected to the South Carolina AIA Board of Directors and organized the statewide workshop on “Design Excellence in Practice” held in Charleston, Columbia, Greenville and Clemson.
- Associate Professor Harry Harritos was named regional director of the Design-Ed Board. Design-Ed is the national organization for design communications.
- Professor Yuji Kishimoto, AIA, received a special commendation from Governor Campbell’s office in recognition of his work with U.S.-Japan relations.
- Associate Professor Robert Hogan was granted tenure. He coordinated college and departmental self-study reports as part of the reporting procedure for SACS.
- Assistant Professor Lolly Tai, ASLA, received a Provost Research Grant to study botanical gardens.
• Assistant Professor Frances Chamberlain, ASLA, continued her work on the editorial board of the *Journal of Architectural Education*.

• Assistant Professor Matthew Rice presented a paper, "On Teaching Architecture," at the ACSA Conference on Beginning Design.

• Assistant Professor Raymond Huff served on the NEA Design Awards Review Board.

• Assistant Professor Whitney Powers' work was featured in the July 1990 issue of *Progressive Architecture* as part of their annual review of young architects.

• Associate Professor Robert Eflin completed the year as the professor-in-residence at the Charles E. Daniel Center for Building Research and Urban Studies in Genoa, Italy.

• Professors John Jacques, AIA, and Lynn Craig served as graders for the 1990 NCARB Design Exam.

• Dean James Barker, AIA, began his second year as the ACSA Southeast regional director; served on the NCARB Education Committee and the 1991 AIA Convention Planning Committee; participated as a member on the Clemson University Strategic Planning Committee; participated on the National Endowment for the Arts Grants Panel to select projects to receive federal support; and was vice chairman of the South Carolina State Board of Architectural Examiners.

**Public Service**

Associate Dean Gayland Witherspoon's efforts this year have brought together an excellent publication of public service projects over the past three decades. This year's work includes:

Second Year: .................... Camden Town Center Redevelopment

Chester Town Center Redevelopment

Fourth Year: ................... Laurens Town Center

Lake City Town Center

First Year (Grad): ........... Penn Center

Freewoods Foundation

Health Care Facilities

Planning Studio: .......... Gerontology and Daycare

**Visiting Critics**

The Distinguished Visiting Critics for the year were Merrill Elam (Scogin Elam and Bray, Atlanta) and Charlie Menefee (Clark and Menefee, Charleston).

**Special Projects**

The second annual spring theme project, "Elements: Elements of the Environment, Elements of Architecture," was conducted in January involving all the second, third and fourth year students and faculty.
Department of Building Science and Management

The 1989-90 academic year was one of opportunity, challenge and concern for the Department of Building Science.

Effort was expended toward alleviating the weaknesses identified during the ACCE accreditation process the previous year. The comprehensive assessment process continued through student faculty evaluations, exit interviews by the department head with graduating seniors, faculty evaluations by the department head, and evaluation of the department head by faculty. Since the department already had in place an assessment procedure, the job of the SACS Department Committee was made much easier during the University accreditation process.

The fall 1989 semester began with a half-day faculty retreat at the Strom Thurmond Institute August 21, 1989. Attention was given to major agenda items, such as reviewing and revising the one- and five-year goals for the department, curriculum matters, faculty evaluations and updates to the Departmental Operations Handbook.

A faculty/student retreat was held at the Outdoor Lab January 23, 1990. Mr. Ken Braswell, of The Brawell Company in Charlotte, N.C., taught a workshop on leadership, attended by 70 percent of the student body. Feedback from students was positive, and the department plans to continue this yearly activity.

A year-end faculty retreat was held at the Keowee Key Yacht Club May 9, 1990. The group reviewed the year's activities focusing on admission procedures, curriculum, and tenure and promotion guidelines.

The Clemson/ABC Partnership prospered during the year, offering 13 academies: six for supervisors, four for project managers and three for safety managers. To date, more than 500 individuals, representing over 240 companies throughout the United States, have participated in this unique training effort. In response to requests, a four-day Estimating Academy is being introduced with the fall 1990 program and will be taught by three department faculty members.

In co-sponsorship with the South Carolina Home Builders Association, six more Graduate Builders Institute courses were offered. A number of individuals completed the requirements in the series of courses during the spring classes.

The department rewrote the examinations for the South Carolina Licensing Board for Contractors and has a new three-year contract to maintain them.

The department established a National Construction and Research Fund to support development of a facility to house construction education and research activities. This facility will be a focal point on campus for construction education and research activities involving other departments, such as Civil Engineering and Management, as well as other universities with construction programs. In addition, it will serve as a forum to disseminate results of research performed by other construction-related organizations.

The annual national meetings of the American Institute of Constructors and the Associated Schools of Construction were hosted by the department and held in Charleston during consecutive weeks in April. Faculty, staff and students were involved in this effort, and feedback has indicated "the best meetings ever." A highlight of the AIC meeting was Dr. Roger Liska receiving the prestigious W.A. Klinger Construction Educator Award.
A fund-raising campaign during the year brought $5,325 to the department’s PDP account and endowment. In addition, three major funding proposals were finalized and given to the Development Office for review and location of prospective sponsors.

In memory of one of the department’s outstanding students, Greg Williamson, who died in a water-related accident in June 1989, a scholarship fund was established. The department participated actively in this effort, and a Greg Williamson Memorial Scholarship will be established to honor the young man.

Student enrollment increased to 114 undergraduates, seven full-time and seven part-time graduate students, and one student in a post-bac status. Additionally, a number of non-degree students are participating in the Telecampus courses offered by the department.

Two ad-hoc committees were formed to look at curriculum matters in the department: a Structures Study Group and a Construction Management Study Group. Both groups reported at the year-end retreat. Courses approved during the year were the interdisciplinary course The Team Approach; Advanced Acoustics; and Advanced Lighting. Modifications are being made in the structures courses: BLDSC 201 will include an introduction to axial stress; BLDSC 202 will include direct stress at the beginning of the course; masonry will be deleted from BLDSC 301 and added to BLDSC 302. Suggested by alumni, recommended by the American Council for Construction Education and the Student Advisory Committee, and approved by the faculty, the name of the department, programs and degrees will be changed to Construction Science and Management. This change will be pursued through proper channels during the coming year.

Research and public service activities increased during the year and include the following:

• The department was successful in obtaining an $80,000 grant from the National Association of Women in Construction to revise the Certified Construction Associate program curricula. This is a two-year effort with work beginning this summer.

• A $7,000 grant was received from Texas Instruments through the North Texas Chapter of Associated Builders and Contractors to develop an eight-week course on Quality Management. TI will require all contractors on their bid list to take the course. In addition, a one-day overview course on Quality Management has been developed for architects who want to work for the firm.

• A proposal has been submitted to the Northern New Jersey Chapter of Associated Builders and Contractors to conduct research on “The Economic Impact of the New Jersey Prevailing Wage Law.” The contract would be for $15,000 for a one-year period.

• A $2,000 grant was received from the Construction Industry Cooperative Alliance to investigate what is being done to attract and train construction workers in the Southeastern United States. The product of the study will be a document which a contractor can use to attract trained workers, the industry’s major problem today.

In addition to the administration of the above activities, Dr. Liska traveled extensively for the department during the year. He attended regional and national meetings of Associated Builders and Contractors, Associated General Contractors of America,
American Institute of Constructors, American Council for Construction Education, Associated Schools of Construction and the National Association of Women in Construction.

Dr. Liska was invited to join the Construction Industry Institute and now serves on the Zero Accidents Safety Task Force for that organization. He is president of the American Council for Construction Education and initiated a Strategic Planning Session, facilitated by the Langlow Company, for the Board of Trustees. Much time and effort have been spent on establishing the mission and goals for the organization. Dr. Liska is a national board member of the American Institute of Constructors and serves as chairman of the Publications Committee. He also is the department’s representative on the Steering Committee of the Construction Industry Cooperative Alliance.

Dr. Liska taught a three-day workshop for the Clemson University Housing Institute and citizens of the state on the topic of “How to Buy a Home.” The workshops were held in Myrtle Beach, Columbia and Rock Hill over three consecutive weeks during April and May. In conjunction with this schedule, regional meetings were held with alumni in Columbia, Rock Hill, Charleston and Florence. An alumni network is being established in these areas, with an alumnus serving as coordinator in each location.

In addition, Dr. Liska has signed a contract with McGraw-Hill Book Company to co-author a book with Professor Schuette on construction estimating.

Faculty in the department were busy fulfilling assigned teaching duties, advising students, serving as advisers for student organizations, serving on department, college and University committees, participating in community and church organizations, attending professional development seminars and workshops, performing research and public service. Many of the faculty serve as officers and committee members of national, regional and local construction organizations.

Significant Faculty Accomplishments

- Professor Clarence Addison attended the Architectural, Engineering and Construction Conference in Anaheim, Calif., the AISC Load and Resistance Factor Design Conference in Greenville and a Franklin Institute time management seminar. He also assisted the Clemson University Housing Institute in reviewing their educational materials.

- Dr. Norman Book joined the American Concrete Institute during the year and attended one of their meetings, an ASHRAE Conference, the AISC Lecture Series and CRSI workshop. He also also attended the “Writing Across the Curriculum” workshop. In addition he served as chairman of the Structures Study Group for the department.

- Professor Greg Corley attended the Engineered Wood Systems Workshop held at Clemson, an AutoCad Training Class, the ACSA Construction Materials and Technology Institute at Harvard University, the CICA Industry Forum on “Total Project Management” and a Franklin Institute time management seminar. He is a member of ASCE and AIC and attended national, regional and local meetings of American Institute of Constructors, Associated Schools of Construction, Associated Builders and Contractors and the National Association of Home Builders. He also obtained his Professional Engineer’s license in South Carolina.
• Professor David Egan attended the INCE International Noise Conference in California and continued to serve as the national awards coordinator for the Robert Newman Student Award Fund. Professor Egan holds membership in the Acoustical Society of America, where he is chairman of the committee on Architectural Acoustics Education; serves as associate editor of Noise/News of the Institute of Noise Control Engineering; former national vice president of the National Council of Acoustical Consultants, the American Society of Heating, Refrigeration and Air Conditioning Engineers, the National Fire Protection Association and the Illuminating Engineers Society. In addition, he has received a contract for a book, Spaces for Music and Speech: An Acoustical Guide, to be co-authored with Dr. Christopher Jaffe, Norwalk, Conn. His book, Concepts in Building Firesafety, is being translated into Serbo Croatia by John Wiley & Sons.

• Professor Francis Eubanks attended the the regional and national meetings of the Associated Schools of Construction where he presented papers; served as the secretary/treasurer of the AIC Piedmont Chapter; and attended meetings of the Construction Financial Management Association. He attended the ACSA Construction Materials and Technology Institute at Harvard University and a one-day seminar on “How to Influence People,” held in Columbia. He continued the research for the Faculty Enhancement Award, which should be completed by the end of the summer. He had a paper published in the August 1989 edition of the AIC Journal and a paper accepted for presentation at the annual national meeting of the Real Estate Education Association.

• Professor John Mumford is a member of the American Institute of Constructors and The Masonry Society. He attended monthly meetings of the Piedmont Chapter of AIC as well as the national forum. He also attended regional and national meetings of the Associated Schools of Construction at which he lead a discussion group on methods/materials of construction. He attended the “Writing Across the Curriculum” Workshop at Clemson, the ACSA Construction Materials and Technology Institute at Harvard and the Engineered Wood Systems Seminar at Clemson, which he also helped facilitate.

• Professor Steve Schuette was promoted to full professor. He is active with the American Council for Construction Education (vice chairman of Standards Committee and team chairman for site visit to University of Oklahoma); Associated Schools of Construction (regional director, national board member and national chairman of Industry Relations Committee); The Merit Shop Foundation (National Educational Advisory Committee); American Institute of Constructors (president, Piedmont Chapter). He also taught “Cost Awareness and Computers” at the ABC Academies and “Construction Estimating” to the Pennsylvania Chapter of ABC. He received a $2,000 grant from the Clemson University Housing Institute to conduct a study on the cost of residential construction. He was successful in having Timberline donate the full Precision Estimating Program to the department and has a positive commitment to have a $4,000 digitizer donated. Professor Schuette has signed a contract with McGraw-Hill to co-author a book with Dr. Roger Liska on construction estimating.
Major concerns of the department during the year included class sizes, teaching loads, space limitations, first year design, integration of building science and architecture, and the tenure and promotion guidelines. As state appropriations are available, it is hoped that space will become available for faculty offices, laboratories and classrooms. The hiring of another faculty member, beginning fall 1991, will help alleviate the teaching loads of faculty. Admissions policies and close scrutiny by the administration will help alleviate the problem with large class sizes. The addition of a second full-time clerical position in the department has helped tremendously with the secretarial/clerical workload.

Landscape Architecture Program

Significant Faculty Accomplishments

The year began with the addition of Frances Chamberlain to the program as an assistant professor of landscape architecture. Professor Chamberlain comes to Clemson from the University of Texas. She has a Master’s in Landscape Architecture from the University of Virginia. Her work experience includes offices in New York City and Houston. Her specialties include design theory and design history. She will teach in the second year design studio as well as teach history and theory of landscape architecture. In the spring semester she also will teach a theory seminar that spins off of the design history course. Professor Chamberlain’s strength is her method of teaching design history — a method that involves a measure of graphic exploration as a means of understanding the events and concepts that have shaped noteworthy environments. Professor Chamberlain continued to serve, with college support, on the Journal of Architectural Education Review Board.

Professor Lolly Tai returned for her second year of work in the program and taught in the second year studio. She also taught the first classes in Landscape Architecture Technology, CALA 262 and CALA 362. Professor Tai, during the course of the year, served on the College of Architecture’s Committee for the University SACS Accreditation Study. Professor Tai completed work on her Provost Grant. Professor Tai assisted the campus planning and design offices on several sites and committees, including revisions to Lee Hall, which have been carried out.

Both Professors Tai and Chamberlain have been reappointed for next year and continue to make satisfactory progress toward tenure.

Don Collins, ASLA, professor of architectural studies, continues to serve as program coordinator, and the Landscape Architecture Program remains assigned to the Office of the Dean. Professor Collins taught third year architecture and landscape architecture students in the fall semester. During the spring semester, he was on sabbatical leave, but continued to serve on juries, University committees, one graduate committee and the Administrative Council.

Staff

Wanda Whitmire became the program’s part-time assistant. Soon this position will have to become full-time if the program is to function effectively with its increasing student enrollment.
Students

The student body continues to grow. With attrition, the program had 33 students at the end of the year. For the coming fall semester, the University has admitted 26 additional students. Applications are greater than expected, and matriculating students are in line with the numbers projected by Professor Caban in his data for the program. All students are meeting the high standards for College of Architecture admission. The $1,000 CAF Scholarship will be used as an award for a rising fifth year student.

Robert Anderson, a third year student, was instrumental in establishing a Clemson Student Chapter of the American Society of Landscape Architects. This group has applied for a section of state highway to adopt for litter control.

With the advent of a full third year program, visibility of the Landscape Architecture Program will be greatly enhanced. For the first time in the fall, there will be a designated Landscape Architecture Studio.

Public Service

This year students and/or faculty worked on public service projects for the city of Camden and the city of Liberty. Many requests for public service projects fit well into the Landscape Architecture Studio environment, and the faculty anticipate an increase of participation in this area.

Department of Planning Studies

The 1989-90 academic year was a successful one for the Department of Planning Studies. Highlights of the year include:

• continued coordinated work of five tenure track faculty, with the implementation of a new curriculum;
• revised thesis/terminal paper process, with graduation of seven out of nine students;
• received $410,000 grant from HUD for 17 student work-study awards for 1989-91;
• recruited the largest first year class (20 students) in 1989, with a 1990 class of similar size expected;
• increased research and public service activities.

Curriculum

Based on faculty review in light of PAB accreditation of the department as well as current trends in planning, the curriculum was revised in 1988-89 and implemented this year. Major aspects include more integrated sequences in economics/economic development theory and methods, more coordinated skill building in physical, social and policy areas, integration of skills and knowledge in a second year, six-credit studio and a structured thesis/TP course sequence. New course sequences were developed in environmental planning and geographic information systems.
Recruiting

Consistent with University goals of increasing both the number and quality of graduate student enrollment, the department has continued to focus on recruiting. During 1989-90, 35 students were in the program, with 20 students in the first year. Recruiting trends indicate the following:

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<tbody>
<tr>
<td>1988 U.S. Applicants</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td>1989 International Applicants</td>
<td>13</td>
<td>15</td>
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<tr>
<td>Total Applicants</td>
<td>26</td>
<td>46</td>
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<tr>
<td>Acceptances</td>
<td>12</td>
<td>32</td>
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The quality of accepted students has been increasing, with an average GPR of 3.16 and average GRE of 1603. These values are well above the values required for admission of 2.7 and 1500 and are improvements over the 1989-90 values.

The yield of eventual enrollees is directly related to the number of assistantships that can be offered, regardless of the total number of acceptances. Naturally, increasing acceptances remains an initial goal. The next step is to enlarge financial aid resources in the department, both from the E&G budget as a result of greater enrollment and from external sources.

The number of externally funded assistantships has increased from 13 to 15, in part due to three HUD positions. This number represents 68 percent of the 22 graduate student assistantships funded externally in the college. In addition to the three HUD students, 10 students were public service assistants in various agencies in Anderson, Pickens and Greenville counties, and two students were supported on projects funded by the State Development Board and the South Carolina Chapter of the American Planning Association.

The HUD grant received last year provided three work-study assistantships. This year’s HUD award will fund 10 rising second year students and seven entering first year students. All 17 grant recipients are minority or economically disadvantaged students. This $410,000 grant was the result of Professor Herbert Norman’s proposal and is one of 29 such grants in the country.

Research and Public Service

Faculty and student assistants were engaged in completing work on more than $200,000 in funded projects in 1989-90. These included Provost Awards to Professors Brooks and Norman, a multi-disciplinary project in Anderson, and a major impact assessment/geographic information system (GIS) study funded by the South Carolina Development Board, Appalachian Regional Commission and Cutting Edge monies. Applications are currently pending for projects and research funding regarding post-Hugo planning, solid waste management, rural health issues in the state and mapping impacts of climate change in the Southeast.

It is the objective of the department to continue active involvement in funded research and public service projects. The revised curriculum offers the flexibility to incorporate
projects into the new second year studio. Funding for selected terminal projects/theses will be sought when the project can also serve as a public service effort.

**Significant Faculty Accomplishments**

The five full-time faculty members were quite active during the past academic year. In addition to chairing and serving on a variety of college and University committees, most faculty members served on architectural juries and thesis and dissertation committees.

Highlights of the year include:

- All five faculty members presented papers at the 1989 Association of Collegiate Schools of Planning Conference in Portland, Oreg. This is an impressive demonstration of departmental research activity and interest.

- Professors Herbert Norman and Barry Nocks attended the national American Planning Association Conference in Denver, Colo. Dr. Nocks presented a paper at that conference, and 12 planning students obtained funding from a variety of sources to attend the conference.

- Professor Norman served as a lecturer for the Palmetto Leadership Program, speaking to a number of county groups across the state.

- Professor Jose Caban, head of the department, was on sabbatical leave for the spring semester 1990. He spent the semester living in Spain, studying that country’s urban form.

- Dr. James London presented a paper on environmental issues at the Caribbean Conservation Foundation, GIS papers at the North America and Southern Regional Science Association meetings, and completed work on sea level change implications in the Myrtle Beach area.

- Professor Kerry Brooks was a co-author with Dr. London of the GIS papers presented at the Regional Science meetings, spoke at several GIS-related conferences, and gave several presentations in the state regarding open space planning and agriculture land preservation.

- The department has continued to publish the *Palmetto Planner*, a quarterly newsletter for the SCAPA, and has been represented on the Executive Board of this organization.

**Department of Visual Arts and History**

The department emphasized excellence and creative activity in five major areas during 1989-90: MFA graduates, the honors program, British Studies Abroad, visiting artists and faculty accomplishments.

Graduates of the Master of Fine Arts degree program continue to bring recognition to themselves and the program through professional activities. The faculty receive continual reports of their success in exhibitions and employment. One significant highlight regards Richard Lou '86, who was invited to participate with his artist group (BAW/TAF of San Diego) in the Venice Biennale as a representative artist for the U.S. exhibition. This is one of the highest, if not the highest, career honors a visual artist can receive.
The Art and Architectural History honors program continues to develop as one of the finest in the University under the direction of Alumni Professor Cecilia Voelker. There are more College of Architecture students enrolled this past year than ever before. Dr. Voelker conducted an intensive one week field trip to New York City for these students in the fall semester, and she has developed the first stand-alone honors course in our college, Interdisciplinary Studies in Art and Architecture, which will be offered in the fall semester of 1990.

The first offering of British Studies Abroad was possibly the largest of any foreign studies program at Clemson University. Four professors, including Vice Provost Jerry Reel, conducted on-site lectures in England using London as the home base. Sixty-four students enrolled in this 10-day intensive study abroad course. The success of this venture has placed the department in a position to plan for an Italian Studies Abroad course for the spring semester of 1991.

The second year of the Visiting Artist Series was equal to the first in quality, and the number of participants doubled. This year the series invited artists and lecturers from the concept of expanding circles from state to regional to national and international. Twenty-three artists/lecturers participated. Eight of these were faculty from the University of South Carolina Art Department as this year was the second half of the Clemson-USC faculty exchange program.

Significant Faculty Accomplishments

Faculty professional activity, research, creative work and service included the following:

• Dr. Cecilia Voelker continued her research on quarantines for publication and her development of SEAAD (Southeastern Art and Architecture Database).

• Professor Sydney Cross organized and printed the art faculty portfolio exchange with Mississippi State University. Her creative work in printmaking was exhibited in group exhibitions in the Southeast and Southwest.

• Professor Mike Vatalaro’s ceramic sculpture was exhibited in the South Carolina State Museum as a part of the South Carolina Artist Fellowship Exhibition. Professor Vatalaro served as a panelist in the South Carolina Arts Commission Conference on the Arts in the conference session, “Craft as Fine Art.”

• Professor Bob Hunter continued his creative work on his large exhibition, “Space Age.” He served on the University Scholarship and Awards Committee and was chairman of the Departmental Peer Evaluation Committee.

• Professor Janet LeBlanc devoted this year to service as one of the college’s two faculty senators and as a member of the International Studies Committee.

• Professors John Acorn, head of the department, and Tom Dimond had a two-person art exhibition at the Goodall Gallery at Columbia College. The exhibition was composed of 10 new works of sculpture by John Acorn and 20 new paintings by Tom Dimond.

• Two of the faculty, John Acorn and Tom Dimond, were commissioned by Tri County Technical College to create art works for the new library and administrative building.
• Professor Terry Jarrard Dimond, Clemson MFA graduate and visiting assistant professor, received a commission from Tri County Tech for a major artwork for the lobby entrance.

• Three of the faculty, Sydney Cross, Tom Dimond and John Acorn, were selected to exhibit in a competitive exhibition, The Fifteenth Annual Juried Exhibition, at the Anderson Art Center, Anderson, S.C.

• Professor Sam Wang’s creative work in photography and computer prints was part of a traveling exhibition organized by the Southern Arts Federation/NEA on their fellowship winners. His photographs also were selected for the Iron Bridge Traveling Exhibition and published in the 6th edition of the text, Photography, by Phil Davis.

• Professor Tom Dimond received a merit award for his painting exhibited in the Guild of South Carolina Artists Annual Exhibition at the Florence Museum. He also was invited to be a resident artist at the Hambidge Center for Creative Arts and Sciences in Rabun Gap, Ga.

• Professor Jon Meyer wrote art reviews that appeared in the New Art Examiner in October 1989 and Art News in January 1990. Professor Meyer also wrote the catalog essay on the artist Ed Rice for his exhibition at the Heath Gallery in Atlanta.

• Professor Jim Buonaccorsi exhibited his sculpture in three invitational exhibitions: “Mental Metal” at the National Ornamental Museum; “Small Metal” at the Oak Ridge Art Center; and “Industries End Game” at Walker State College. All exhibitions were in Tennessee.

The growth and interest in the studio arts in South Carolina and locally have very much increased in recent years, and the faculty have become a vital part of that growth. In the not too distant past, the faculty were perceived as having professional interests that were focused nationally and regionally. There now seems to be a balance between these research/creative interests and those that are local in nature. The department wishes to encourage the further development of research/creative work at all levels of participation and contribution.

COLLEGE OF COMMERCE AND INDUSTRY

School of Accountancy

During the 1989-90 academic year, the School of Accountancy graduated 78 B.S. students and 18 Master of Professional Accountancy students. Of the B.S. graduates, 19 percent graduated with University honors. Placement of undergraduate and graduate accounting students compared favorably with national averages. The School of Accountancy is recognized as a primary recruiting school for major accounting firms in
Georgia and the Carolinas. Enrollments in the undergraduate and graduate accounting programs continue to grow.

A significant development during 1989-90 was the receipt of a grant of $18,900 from the KPMG Peat Marwick Foundation to support the acquisition and maintenance of an on-line, computerized tax research database. Access to this database represents a significant enhancement for the tax faculty and students.


The internal auditing program continues to attract a significant number of students. The program has received outstanding support from the internal auditing profession in major manufacturing, retail and financial institutions. During this second year, placement of internal auditing students in permanent and internship positions has been excellent.

National recognition was once again brought to the school by the Clemson Chapter of Beta Alpha Psi, the national honorary and professional fraternity, as the chapter earned a distinguished chapter award in the national competition. The award also results in a scholarship provided by the KPMG Peat Marwick Foundation for a chapter member.

In the professional service area, seven faculty members served on national boards or committees of professional accounting organizations. Several continue to hold office in local and state chapters of professional accounting organizations.

**Department of Economics**

The most important measure of success for an academic department is the success enjoyed by its graduates. The Economics Department is proud to report this year that its first Ph.D. student received an appointment to the University of Chicago business school as an assistant professor of finance.

Encouraged by this good news, the department plans to expand its graduate education curriculum and has officially notified the Commission on Higher Education of a proposed Ph.D. in financial economics. The research direction of the department has long been swayed toward financial and managerial economics issues. Hence, a natural extension of the Ph.D. in applied economics, jointly offered with the Department of Agricultural Economics, is a degree specializing in finance, management and contracts.

The professional record of the faculty over the year was notable. This year articles by Clemson scholars appeared in numerous journals, including *Journal of Political Economics, Journal of Law & Economics, Journal of Labor Economics, Quarterly Journal of Economics* and *Journal of Econometrics*. While the volume of this research is impressive, its quality is even more important. The journals listed above are the best in the profession.

Undergraduate studies continues to be the foundation of the department even as research goals are pursued and graduate offerings are expanded. An important step in improving the quality of the undergraduate experience was taken this year. Funded by a
$250,000 grant from the Harris Family, an annual program to bring a nationally recognized scholar to Clemson for a week or more was started. During this time, a series of lectures is given to the undergraduates. The program concludes with a banquet honoring both the visitor and the students. This year the speaker was William Briet, a well-known economist who spent most of his career at the University of Virginia, where his research interests centered on models of public choice.

Four Ph.D.s in applied economics, 11 Master of Arts and 37 Bachelor of Arts and Science degrees were granted.

Department of Finance

The Department of Finance continued to be among the nation’s leaders in undergraduate finance education in 1989-90. Growing to just under 900 majors, the financial management (FM) program became the second largest major at Clemson University. FM graduates continue to be highly sought after by firms throughout the nation. This is partly because FM majors take a more rigorous program of accounting and finance courses than those in finance programs at other universities.

In the area of private financial support, First Union National Bank of South Carolina announced last October its major commitment of over $100,000 to establish and fund the First Union Professorship in Banking. This crucial position was filled after a national search when Professor Wayne Marr agreed to leave Tulane University to take the post beginning in July 1990. Other banks, real estate brokerages, firms and individuals committed their support for five new awards and scholarships during the year.

Clemson’s finance faculty strive to conduct research that is both relevant and of value to students in the classroom. Three faculty members had particular success this year. Scott Barnhart, working with co-authors at other universities, published two important papers in major journals. In the Journal of Macroeconomics he addressed economic forecasting models that contain equations with perpetual inventory capital. His other paper tested the forward interest rate hypothesis and was published in the prestigious Journal of Financial and Quantitative Analysis.

Mike Spivey co-authored a paper in the same prestigious journal. His paper tested a theory and documented the fact that shelf registration of securities raises underwriters' risks and therefore raises their sales fees. Spivey also wrote a paper with John Harris, published in the Journal of Business Research, that supports the notion of rationally priced securities even in the face of events in the stock market like Black Monday in October of 1987. Harold Mulherin, on leave at the Securities and Exchange Commission, co-authored two papers: one on stock price response to pension terminations as a part of corporate takeovers, published in Financial Management; the other an examination of "shark repellants" aimed at preventing hostile takeovers, published in the Journal of Political Economy.

The department lost the services of Mark Mitchell to the University of Chicago, and Bill Kelly to the Credit Union National Association in Madison, Wis. Harold Mulherin will remain on leave at the SEC for the 1990-91 academic year. New faculty hired for the coming year include Wayne Marr (already mentioned), Uma Sridharan (Ph.D., University of Iowa) and John Alexander (Ph.D., Florida State).
Department of Management

The Department of Management continued to be a leader in management education, with more than 1,000 majors enrolled in the department’s bachelor’s, master’s and doctoral programs, and more than 9,000 students taught during the year. The department received the South Carolina Commission on Higher Education Commendation for Excellence for its Bachelor of Science program in industrial management. This was one of only two awards given to university departments across the state.

Quality teaching and research continued to be a primary goal of the department. Four positions to enhance this educational role were filled during the year: a production position filled by Lawrence D. Fredendall, a management science position filled by Janice L. Miller, an organizational behavior position filled by Tina L. Robbins and the department head position filled by William H. Hendrix. A new graduate course, Manufacturing Planning and Control Systems (MGT 808), was approved to provide M.S. and Ph.D. students hands-on experience with the Manufacturing Management Laboratory systems. The Manufacturing Management Laboratory was expanded with the implementation of JOBSCOPE, an integrated software system for manufacturing planning and control in a make-to-order environment. With the addition of JOBSCOPE, the laboratory provides students and faculty the opportunity to work with fully integrated systems for manufacturing management in market situations ranging from standard products to one-of-a-kind items.

The Manufacturing Management Laboratory continued to receive attention from industry and academia as a model for innovative teaching in operations management. Dr. Larry LaForge, who developed and operates the laboratory, gave an invited presentation on the laboratory program to the IBM Business School Computing Conference, which was attended by 150 business school deans throughout the United States. Based on his work with students in the laboratory, Dr. LaForge was named the Outstanding Member of the Industrial Crescent Chapter of the American Production and Inventory Control Society and was appointed as the chair-designate of the Innovative Education Committee of the Decision Sciences Institute. Dr. LaForge was selected as Clemson University’s nominee for the 1990 Council for the Advancement and Support of Education (CASE) Professor of the Year Award.

Additional programs were initiated to make education relevant to industry. The department expert systems course evolved to provide expert modeling for industry. Prototype expert systems were built for organizations such as Duke Power Company, Clemson Fire Department and area textile plants. Dr. Richard Clarke performed research for Bausch & Lomb to help their distribution manager expand warehouse space. Dr. Clarke also worked with 34 S.C. manufacturing companies on a study of productivity of the distribution function. Dr. John J. Kanet continued his research with the Defense Logistics Agency on production planning for quick response in the apparel industry. Management department professors developed a computer-based system to help managers considering capital investment alternatives. This system accounts for riskiness of anticipated benefits on a sound financial basis.

The first phase to improve the education, research and administrative support functions of the department by developing a Local Area Network (LAN) were initiated. The
first phase included the purchase of LAN connectivity equipment to be installed over the next year. The Local Area Network (LAN) will provide connectivity between computers in each administrative and faculty office within the department with the NAS mainframe, the department’s mainframe and on a selective basis with the Manufacturing Management Laboratory. This will provide professors with the capability in their office to help students with computer related educational programs located on the computer systems. Equipment was purchased to provide state-of-the-art computing capability (IBM AS 400) for the Manufacturing Management Laboratory. In-class computer instruction capability was expanded to allow computer images of educational programs to be presented on a large screen using LCD projection capability.

Five Industrial Management Research Center Awards were granted to management faculty this summer. The funded research covered the following topics:

- A study of alternative shop loading/scheduling procedures.
- How to select the best system for manufacturing planning and control.
- A multivariable model of technology transfer strategies in multi-domestic firms.
- In search of synergy: synergistic effects on post merger/acquisition performance.
- Strategic capacity planning.


**Department of Marketing**

The Marketing Department continued its rapid growth in undergraduate majors during the 1989-90 academic year. During the past three years, the number of students majoring in marketing has grown at the rate of 15 percent per year. Presently, the department has approximately 800 majors. In addition, marketing continues to be a popular elective for students in other colleges throughout the University.

Two new tenure-track faculty members have been added, bringing the number of marketing faculty to 13. Dr. Less Carlson, associate professor, comes to Clemson from the University of Arkansas where he spent five years. Dr. Carlson brings a wealth of teaching and research experience to the department and will add significantly to its growing stature. Dr. Donald McBane also will join the faculty after completing his Ph.D. this June at Texas Tech University.

This past year the Marketing Department embarked on an examination of its curriculum, resulting in the decision to offer concentrations in “technical marketing” and “services marketing.” New courses are being developed, and these concentrations
should be in place by the 1991-92 academic year. In addition, the department is exploring the possibility of developing a master's program in technical marketing.

The 1989-90 academic year was another good one for the department in terms of research and publication. Faculty research was published in 14 scholarly journals including the Journal of International Consumer Marketing, Journal of Marketing Education, Journal of Business Ethics, Journal of Business and Industrial Marketing, Journal of the Academy of Marketing Science, Industrial Marketing Management and Psychological Reports. In addition, the marketing faculty presented numerous papers at all of the most prestigious national meetings. The faculty made its presence felt in professional organizations. One-third of the marketing faculty now serve on the editorial review boards of scholarly marketing journals; several hold offices in local, regional and national associations.

The marketing faculty provided service to the community as well. By way of example, Dr. Charles Duke undertook a readership study for the Greenville Chamber of Commerce. Furthermore, Dr. Duke, in conjunction with a colleague in the Department of Forest Resources, received a $30,000 grant from a coalition of state agencies.

School of Textiles

The School of Textiles continued its emphasis on obtaining sponsored research as a means of serving the textile industry and the state. Several new contracts were funded, and extensions were obtained for several existing contracts. The sponsored efforts at the Apparel Research Center also increased. Members from the textile programs at N.C. State, Georgia Tech, Auburn and Clemson have begun work on a project, which will eventually lead to a federally funded consortium involving the four schools, to provide coordinated research efforts to serve the nation's basic textile industry.

Numerous additions have been made to textile capabilities through purchase and donation of equipment for the instrumentation, testing and processing laboratories. Such additions not only enhance educational programs, but also provide additional capabilities to support research efforts.

Two new individuals were hired to enhance teaching and research programs. Dr. Richard Gregory, formerly with Milliken Research, will join the faculty in August. With a strong research record, he is expected to contribute much in both the classroom and in the research program. Richard Crenshaw joined the technician staff in January to operate the dying and finishing laboratories.

Recruiting efforts have continued to receive a great deal of effort, with presentations being given at approximately 85 high schools throughout the state. Special emphasis has been given to the recruitment of students into the textile science and textile chemistry programs. Applications to the graduate programs were up this year, with five or six students entering this fall.

Professional Development

The Office of Professional Development posted its best enrollment ever in 1989-90, generating an attendance of more than 22,000 people in business-oriented continuing education seminars and conferences across the country.
Some of the year’s highlights for the College of Commerce and Industry’s outreach arm include:

- Produced more than 50 textile and apparel technical conferences on a wide range of topics critical to one of the South’s largest industries.
- Held a unique one-day conference for textile executives, “Resurgence of Textile Excellence in the 1990s,” featuring a number of notable speakers and attracting an audience of high-level attendees from across the industry.
- Initiated its first ever Fasteners Technology conference to address the complicated issues of modern joint design crucial in manufacturing processes and product design, attracting more than 100 participants.
- Developed 20 conferences — 11 more than last year — devoted to the professional enrichment of women.
- Hosted the greatest number of people ever to attend a Professional Development conference at the Professional Development for Women one-day conference in Lansing, Mich., with more than 400 attendees, an all-time high in PD’s 32-year history.
- Launched a successful management seminar line devoted principally to media-based training in printing, graphic design and desktop publishing.
- Continued to forge new international bonds by developing three- to six-month tutorial training programs for the Agency for International Development.
- Created the Quality Forum, an outstanding series of eight seminars designed to equip the 20th Century manager with the skill to fuse “quality” management with proper statistical technique and interpretation.
- Expanded personal computer training in such areas of business as statistical quality control, project management, personnel management, publications design (desktop publishing) and database development.
- Purchased an on-line computer system to improve customer service and increase marketing responsiveness.

Small Business Development Center (SBDC)

The Clemson University Regional Small Business Development Center continued to assist the small business community in the 11 northwestern counties of South Carolina. Through its administrative offices located on campus and three area offices located in Greenville, Spartanburg and Greenwood, the SBDC has fostered economic development and growth. During the past fiscal year, the Clemson SBDC has assisted in excess of 1,000 clients more than in any of its previous 10 years. Trends indicate that the Clemson SBDC operation will conclude the year at more than 200 percent of annual deliverable goals. In addition, the Continuing Education Division conducted more than 20 seminars on relevant small-business management topics.

The center administers a Defense Logistics Agency grant for the establishment of a federal procurement assistance program for small businesses. As a result of this program, now in its third year, several large procurement contracts should be awarded to
small businesses in the Clemson area. The core mission of the SBDC is to provide management and technical assistance to small businesses to reduce the small business failure rate. The Clemson SBDC continued to move into areas beyond its core mission. SBDC staff members have been actively involved over the past two years with a W. K. Kellogg Foundation grant for rural leadership education.

A new program has been established in the area of technology transfer. The Clemson University SBDC, in partnership with the Southeast Manufacturing Technology Center at the University of South Carolina, will serve as facilitator between the colleges and universities in South Carolina, which develop technology, and the small business community, which will implement and commercialize the technology. As a result, the close partnership with the Clemson University Emerging Technology Center remains strong.

Stronger working relationships have been established with several other state agencies such as the State Development Board, the Governor’s Office and the South Carolina Economic Developer’s Association. The SBDC has remained highly visible on campus and has maintained its association with other departments and colleges during the past year.

COLLEGE OF EDUCATION

During the 1989-90 academic year, the College of Education gave special focus to its involvement in the self-study analysis as part of the University’s review by the Southern Association of Colleges and Schools (SACS). In that process, the college conducted an internal evaluation of goals and objectives for the different departments and coalesced their various curricula, priorities and commitments into a unified document to reflect general missions and goals.

The self-study process was among a number of thrusts undertaken by the College of Education during the year. Faculty committees participated in the design and development of new efforts in instruction, inservice and research. The college underwent a restructuring process, which included establishment of an associate dean’s position as well as assistant department heads. Plans were completed for the establishment and appointment of a new assistant dean for research. In addition, such ongoing tasks as appointment of new faculty to replace retiring ones and development of new courses, programs and curricula continued as a college activity and commitment.

Instruction

The mission statement adopted by the Department of Elementary and Secondary Education included the following: (1) prepare teachers for employment in public and/or private schools, (2) provide graduate programs for educators and personnel of community and state agencies, (3) engage in public service activities with educational entities and state and community agencies, and (4) conduct research and scholarly activities related to public and faculty interests.
The department's faculty have focused on the areas of teacher preparation, continuing education conducted through graduate degree programs, extension courses and in-service workshops as well as continued growth in research and scholarly activities. Faculty members have access to network computer equipment and are being trained to implement computer instruction into method courses, along with higher-order thinking skills and strategies for writing-across-the-curriculum program initiatives.

Internal administration was restructured to include two positions designated as assistant department heads. With these additions, the department employed personnel to coordinate curriculum growth among the program areas and to schedule classes and advise students more effectively.

Expansion in the department has continued as reflected in student enrollment figures. Currently, there are 1,001 undergraduates, 100 full-time graduate students and 1,100 part-time graduates.

Bachelor of Arts degrees are offered in early childhood, elementary, secondary, and beginning in the fall 1990 semester, special education. Science teaching is an additional undergraduate program granting a Bachelor of Science degree.

Master of Education degrees are available in the areas of administration and supervision, counseling and guidance services, elementary education, reading, secondary education and special education. The administration and supervision program has an approved Specialist of Education (Ed.S.) degree program.

The Department of Elementary and Secondary Education continued its commitment to place undergraduate students in practical public classroom experiences. For the 1989-90 academic year, 1,483 students were enrolled in courses with field experience components. The first course in which education majors observe in the public schools, ED 100, had an enrollment of 447. Foundation and methods courses likewise provided frequent visits arranged for 510 students to experience the classroom environment. The early childhood and elementary field experience courses, ED 400/401, provided 141 undergraduates with similar extended experiences. During student teaching, there were 105 students placed in secondary schools, 104 students placed in elementary settings and 35 early childhood placements.

Special education enrolled 14 students (undergraduate and graduate) in practica courses. The guidance and counseling program had 44 elementary and 19 secondary placements in practica. Administration and supervision provided practica for 27 students in ED 723 for the elementary principal, 24 students in ED 724 for the secondary principal and 4 students in ED 725, a course for superintendents. The total number of practica students was 132.

Several degree programs were added to the curriculum. A Bachelor of Arts in special education was approved to begin fall 1990. A Ph.D. in science education and a Ph.D. program in curriculum and instruction were reviewed at the University level and are being evaluated by the Commission on Higher Education.

Funding continued for the South Carolina Center of Excellence in Math and Science Education. The center has provided courses for teacher certification in math and science and conducted inservices for continued improvement of teaching skills.

The Model Schools Committee, chaired by the College of Education, developed criteria to help institutions of higher learning better meet the needs of public schools. A
second consortium of universities and colleges focused on ways to assist elementary and secondary schools in the area of restructuring.

On the current topic of at-risk students, the "Visions for Youth" project, funded by the Kellogg Foundation, provided outreach programs aimed at the prevention of potential dropouts. Also, graduate courses on substance abuse were developed and funded to further educate teachers about drugs and alcohol.

The Department of Industrial Education continued to make significant contributions toward its primary mission of instruction, public service and research. Several of the noteworthy teaching accomplishments are reflected in the data related to on-campus and off-campus enrollments for the year. The 15 faculty and 8 part-time faculty taught 52 undergraduate courses and 24 graduate-level courses during the year. There were 141 classes with more than 1,700 students enrolled.

Army and Air Force ROTC programs provided $472,000 in academic aid for 109 Clemson students. In the Air Force ROTC program, approximately $200,000 went to 63 scholarship holders. A student organization for the AFROTC unit, the Arnold Air Society, served as headquarters for the national organization and was selected for more awards than any other detachment in the region. Another AFROTC student organization, Angel Flight, received the most regional awards in its category and was selected as national headquarters for the coming year.

In the Army ROTC program, approximately $272,000 went to 46 scholarship recipients. The Army ROTC's Society of American Military Engineers (SAME) was recognized as a Distinguished Student Post in national competition. Also, the Army ROTC program was designated as Best in the Region in overall performance of all schools on the east coast for 1988-89.

Inservice

The Clemson University campus provided facilities for several educational conferences and meetings. The Clemson Reading Conference attracted 500 teacher educators, public school teachers and school administrators from the Southeast. Project L.E.A.D. sponsored a conference to improve leadership skills of school administrators. The Department of Elementary and Secondary Education hosted the annual meeting of the South Carolina Council on Social Studies. With the Clemson Chapter of Phi Delta Kappa acting as the sponsoring agent, state officers received training during a two-day seminar on campus. In further community-based activities, 500 elementary students celebrated Young Authors' Day at Tillman Hall.

Through the Greenville Higher Education Consortium, faculty taught courses in various programs to area students. Similarly, critical needs and EIA courses were contracted with school districts and funded by the State Department of Education. In regards to local inservices, 72 sessions were conducted in 63 schools. At the national and state levels, 16 professional workshops were presented.

Faculty members in the Department of Industrial Education continued to provide services to public schools, technical colleges and industry. One public service activity included special institute courses for teachers, vocational administrators and industrial workers. Special institutes were held for 48 industrial technology teachers in a continu-
ing effort to update and retrain all industrial arts teachers in the state. About 100 educators were provided a special institute course that brought the educators together with representatives of industry in the industrial environment.

A specific effort designed to provide services to industry was the industrial training program for the printing and related industries. Approximately 158 people from printing and related industries came to Clemson to receive special training in short, non-credit, individualized training sessions.

The faculty served as consultants to school districts, technical colleges and the State Department of Education as well as to industry, professional organizations and other universities. The level and the frequency of faculty involvement in public service activities have increased during the past year.

During the 1989-90 academic year, the College of Education offered through its Office of Extension a total of 232 courses at locations throughout the state. In addition to regular graduate and undergraduate courses that constitute a part of the degree programs in the various education majors, included were offerings in entomology, economics, mathematical sciences, geology, agriculture and industrial education.

In the fall '89 semester, some 73 courses were offered, followed by 82 in the spring, 46 during the first summer session and 31 in the second summer session. Courses included not only graduate and undergraduate offerings in the regular University curriculum, but specially designed courses and institutes to meet the specific needs of individual school districts and other agencies.

The College of Education maintains regional centers in both Greenville and Greenwood, in addition to serving needs of individual districts and agencies throughout the state.

Research, Grants and Related Activities

Faculty in the Department of Elementary and Secondary Education remained active with regard to publications. Seven books, chapters or monographs were published by the faculty. Twenty-seven articles, 10 of which were published in refereed journals, appeared in print. Twenty-one unpublished and 18 miscellaneous works also were submitted.

Presentations were conducted at many levels. Faculty presented at 18 national, 7 regional, 19 state and 24 local professional meetings.

Grantsmanship was evidenced by the 27 grant proposals written and $62,946 added to the departmental budget. Several faculty members participated in grant writing. Griffin (with Fong) received $1,000 to "Investigate Successes of and Stressors on Women Counselor Educators in the Southern Region." Keller and West wrote four proposals that dealt with the education and prevention of drugs and alcohol abuse and were funded for a total of $35,856 by the S.C. Department of Education. Two youth-at-risk proposals funded by the State Department of Education in the amount of $15,174 also were submitted by Keller and West. Leonard directed a problem-solving subproject for the Center of Excellence in Mathematics and Science Education with approximately $56,000 in funding from the S.C. Commission on Higher Education. A $2,000 Clemson University Research Award was granted to Marion for "The Third Annual Clemson
University Survey of the Public's Attitude Toward Public Education." Marion also helped coordinate a grant to evaluate a computerized program for adult illiteracy, which received $67,836 from Cutting Edge funds. Moore and Rogers captured a University Research Grant for $2,735 on "An Analysis of the Metacognitive Content of Guided Reading Statements in Basal Readers Grades One through Eight."

Several faculty collaborated on the $2.97 million Kellogg Foundation project, "Visions for Youth," as well as on the AT&T research project to study the effects of a telephone homework-assistance program, which was funded for $10,000. Edwards Junior High School secured $90,000 with Peters on "Meeting Learning Style Needs with Computers." Weatherford assisted two students with honors project proposals through the Calhoun College Innovative Funds. In conjunction with on-going research activities, 45 unpublished works were submitted, and 10 were accepted for publication.

Recruitment received notable attention by faculty representatives. Peden established cadet programs with five high schools and planned a Future Teachers' Day for regional public school students and their counselors. These efforts contributed to an increase of more than 30 minority students in the department as compared to the previous year.

Several research funding proposals developed by the faculty in the Department of Industrial Education are pending. Five training grant proposals were funded during the year, and five are expected to be funded again next year.

New equipment was purchased to update the industrial technology education laboratories in computer-aided machining, robotics and computer-aided drafting. The graphics area also added a number of pieces of equipment, including a two-color offset press.

The Office of Educational Services continued to expand both the scope and breadth of its activities. The annual Teacher Interview Program (CUTIP) resulted in record numbers of participants, including 70 school districts from six states, 225 attendees and some 1,000 interviews. The annual survey of student teachers and their classroom supervising teachers reflected a strong, positive attitude of University graduates toward the education, preparation and training they received in the College of Education. With some 65 percent response, results in both the fall and spring surveys were predominantly outstanding to excellent on the effectiveness of the teacher education program. As part of its efforts to plan for the future and consider better ways of meeting its goals and objectives, the office surveyed 440 other institutions throughout the nation regarding the feasibility of implementing a computerized placement service and related topics.

Students and faculty are utilizing the college's support facilities on an ever-increasing basis. A substantial addition was made to the inventory of existing materials, including such items as VCR units and accompanying monitors, portable overhead projectors, and related support equipment and supplies. New materials were added to existing collections for use by both faculty and students in many different curriculum areas. These included not only videotapes, filmstrips and similar audio-visual items, but a variety of printed materials as well. In addition, a faculty production area was developed and equipped for use by faculty in designing supplemental classroom materials and demonstrations. Additional computers were provided not only for classroom instructional use, but also to expand the current faculty networking system. Each faculty member now has an office computer and access to a college-wide network.
COLLEGE OF ENGINEERING

As Clemson University enters its second century of education, research and public service, the College of Engineering stands ready to accept the future challenges presented to not only the state of South Carolina, but the nation as well. Similar to those problems posed in the past, these future challenges will test the college; nevertheless, the faculty, students and staff are determined to build upon the excellence and the successes that have occurred for the past one hundred and one years.

As the college looks ahead to the last decade of the twentieth century, there is the sense of continued optimism in conquering the challenges of the twenty-first century. From educating over 60 percent of South Carolina’s engineers to research breakthroughs to public service, the College of Engineering has a long reputation of excellence. The people of South Carolina have known about the college’s excellence for a century. Now others are taking notice.

With only five other schools recognized, Clemson’s College of Engineering was named as being one of the “up and coming” engineering schools in the nation by U.S. News and World Report in their March 1990 ranking of engineering graduate schools on the basis of recent innovations and improvements. Yet, the college doesn’t plan to “rest on its laurels,” and continues to improve the already strong undergraduate and graduate program through innovative programs.

One such innovative program that highlighted the fiscal year is the partnership with Chemical Waste Management to develop methods for safely managing mixed waste. The Environmental Systems Engineering Department and Chem-Nuclear Laboratory Services, a new subsidiary of CWM, will share research efforts in separate buildings to be constructed at Clemson Research Park.

Innovative programs cannot be truly effective without exceptional students, and the college continued to attract the best and brightest students in the University, with 3,150 undergraduate and 562 graduate students (407 in engineering master’s programs and 154 in doctoral programs) enrolled. These totals include agricultural engineering, which is jointly administered by the College of Engineering and the College of Agricultural Sciences.

However, with more bright and talented students entering the college and the increased demand for research, the need for adequate space has become a prime concern. It has been 20 years since the last engineering building was constructed. Within that time, undergraduate enrollment has increased more than 130 percent, graduate enrollment more than 230 percent, and sponsored research has gone from $129,417 to more than $10 million. With the hope that the governor will sign the 1991 bond authorization, the Engineering Innovation Building will give the college additional research facilities and office space. With the architectural designs nearing completion, the college anticipates occupancy of the new building by 1993.

The college had another record year in terms of grants and gifts, led by the largest corporate commitment in Clemson’s history. Chemical Waste Management of Oak Brook, Ill., committed to the college $3.6 million, of which $2 million is guaranteed research funding and $1.6 million is a corporate gift. The University will provide $3.9 million for the initiative and plans to attract another $2.5 million in philanthropic
donations, resulting in a $10 million program. Jerry Dempsey, president of CWM, and his wife, Harriet, pledged $250,000 for The Jerry E. and Harriet Clavert Dempsey Professorship of Waste Management. Gifts received from corporations, foundations and individuals totaled approximately $3.2 million in fiscal year 1989-90.

VALID-Logic Systems, Inc., based in San Jose, gave the Electrical and Computer Engineering Department $1.58 million in software to be used by faculty and students to design digital circuitry. The department also received $94,500 in computer software from Intel Corporation in Hillsboro, Oreg., and $19,984.09 in circuits from Square D Foundation.

Engineer Computer Operations received $1.2 million in computer hardware from Sun Microystems for research use.

The Department of Ceramic Engineering received a VC-250 Sonicator from Sonics & Materials, Inc., for use in the area of dispersions and sample preparations, and a $37,034 Microrc Particle Size Analyzer from Leeds & Northrup to determine particle size in clay. The Environmental Systems Engineering Department received a $500 Germanium Lithium-Drifted Detector for spectrometry research from Tennelec.

Three major commitments also were made to the Engineering Innovation Building, the 100,000-square-foot facility to be constructed in 1992. The Georgia Power Foundation, Inc., and Southern Bell Telephone Company each committed $250,000 for laboratories, along with a $100,000 commitment by RUST International Corporation.

Sherwood E. Liles, retired chairman of Tidewater Construction Company in Virginia Beach, Va., completed his $500,000 endowment of a distinguished professorship, first begun in 1988, in civil engineering with a gift of $250,000. A $500,000 commitment from South Carolina Electric and Gas Company will establish a distinguished professorship in power engineering. The Duke Power Foundation gave $100,000 toward its $500,000 endowment of a distinguished professorship in power engineering. The Fullerton Foundation, Inc., committed $325,000 toward a custom implant design technology program in bioengineering.

Gifts to the college from E.I. DuPont de Nemours totaled $95,000; from Hoechst-Celanese, $56,300; from Dow Chemical Company and Foundation, $29,250; from the S.C. Society of Professional Engineers, $36,100; and from Square D Company and Foundation, $23,000. The Minority Engineering Program benefited from 26 gifts totaling $43,300.

The College of Engineering has undergone some faculty and administrative personnel changes during 1989-90. Dr. Denis R. Brosnan has joined the Department of Ceramic Engineering as an associate professor. Prof. Brosnan holds the B.S. and M.S. degrees from Clemson and a Ph.D. from Iowa State University. He comes to Clemson after 13 years of industrial experience.

Also joining the faculty in the Department of Bioengineering were Drs. Martine La Berge and Vasanti Gharpuray, both as assistant professors. Dr. La Berge holds the B.S. degree in physiology and the M.S. and Ph.D. degrees in bioengineering from the University of Montreal. She joined Clemson following post doctoral studies at the University of Waterloo, and her special areas of interest are biomaterials/polymers, biotribology and solid mechanics. Dr. Gharpuray joins Clemson after completion of a doctoral program of study at Northwestern University. She holds the B.S. degree in civil
engineering from the University of Poona, India, and the M.S. degree in civil engineering from Vanderbilt University, with areas of interest in biomechanics and solid mechanics. Dr. Greg McNeice, professor of civil engineering from the University of Waterloo and consultant in biomechanics, spent a sabbatical year in this department. At the same time, he was employed by the Greenville Hospital System to develop a collaborative research and education venture between Greenville Hospital System and Clemson University. Finally, Dr. Shalaby Shalaby, a polymer chemist at Johnson and Johnson and world renowned expert in resorbable polymer implants, joined the program as a professor. Dr. Shalaby received the B.Sc. degree at Ain Shams University and the M.S. and two Ph.D. degrees at the University of Lowell.

After a nationwide search, the McAlister Chair in Advanced Engineering Materials was accepted by Russell J. Diefendorf, former director of the High Temperature Advanced Structural Composites Center at Rensselaer Polytechnic Institute in Troy, N.Y. A materials engineer with more than 20 patents, Dr. Diefendorf’s expertise includes important work with carbon fibers and composites. The McAlister Chair was established in 1987 with a gift from Laurens industrialist P.W. McAlister and members of his family.

Dr. Darren M. Dawson will join the college as an assistant professor in the robotics and controls area of the Electrical and Computer Engineering Department. Dr. Dawson just received his Ph.D. in electrical engineering from the Georgia Institute of Technology. Before entering the Ph.D. program, Dr. Dawson worked two years for Westinghouse in Pennsylvania.

Dr. William G. Ferrell Jr. joined the industrial engineering faculty as an assistant professor in August of 1988. Dr. Ferrell is involved in advanced systems modeling, especially in the area of manufacturing quality. He holds a B.S. from Wake Forest, an M.S.E. from Virginia Tech and a Ph.D. from North Carolina State University. He also has several years of industrial experience with Babcock and Wilcox.

Within the Mechanical Engineering Department, Dr. John B. Riester was appointed assistant professor of mechanical engineering. His current research interests include using plasma arc technology in processing ferrochromium, solid waste processing and multiphase flow. He holds B.S., M.S. and Ph.D. degrees in mechanical engineering from West Virginia University, along with 11 years of industrial experience with Conoco/DuPont Coal Research Division.

Dr. Sherrill B. Biggers also joined the department as associate professor of mechanical engineering and engineering mechanics. His principal research interests are in the field of composite structural analysis and design. Prior to coming to Clemson, Dr. Biggers was the NASA programs manager for the Lockheed Aeronautical Systems Co. in Burbank, Calif. He served as a faculty member at the University of Kentucky for eight years. Dr. Biggers earned the B.S. degree from North Carolina State University and M.S. and Ph.D. degrees from Duke University.

In the area of college administration, Perry Fulkerson was named as the new director of development for the college. He is responsible for recommending, organizing, and directing activities and programs of the college which involve the direct private support of corporations, philanthropic foundations and individuals — both alumni of the college as well as non-alumni. He comes to the college from Square D Company where he was marketing communications manager. Mr. Fulkerson also has 20 years of experience as a journalist, ranging from managing editor to columnist to bureau chief.
In another key administrative appointment, Dr. Eric Snider was appointed to the position of director of continuing engineering education and lecturer in environmental systems engineering. Prof. Snider received the B.S. in chemistry and the M.S. and Ph.D. in chemical engineering from Clemson University. His previous experience includes faculty positions at the University of Tulsa and industrial experience with Engineering-Science, Inc., in Atlanta, Ga. Prof. Snider replaces Chris Alley, who recently retired.

Other retirements this year include Gilbert C. Robinson, professor of ceramic engineering, who retired effective January 4, 1990. Stephen C. Clarke retired from his position as an instructor in the Industrial Engineering Department in May of 1989. He had served the college in the Engineering Technology and Industrial Engineering departments, following his retirement from a distinguished career with Ingersoll Milling Machine Co. Professor H. Vernon Poe retired in June 1990 after serving the Electrical and Computer Engineering Department for 43 years.

Those professors on leave include Dr. Andreas von Recum, head of bioengineering, who was granted sabbatical leave from June 15, 1990, to June 14, 1991. Dr. von Recum will be doing research in inplantology at the University of Tübingen, Germany. Prof. Dennis L. Powers will serve as interim department head in Dr. von Recum’s absence.

Dr. Paul B. Zielinski, professor of civil engineering, will be on leave from March 16, 1990, to March 16, 1991, to serve as program administrator with the National Academy of Sciences. In this position, he will review research in the areas of hydraulics, hydrology, ocean engineering and atmospheric sciences, which will aid in future programs of the Water Resources and Research Institute. Prof. Earl J. Hayter will serve as interim director of Water Resources Research Institute in Dr. Zielinski’s absence.

Dr. William J. Kennedy, professor of industrial engineering, will be on leave from July 1, 1990, to May 30, 1991, serving as a visiting professor of systems engineering at the U.S. Military Academy, West Point, N.Y.

Dr. Reda M. Bata, associate professor of engineering graphics and mechanical engineering, and Dr. John E. Jackson, associate professor of mechanical engineering and engineering mechanics, have resigned from the college. Dr. Bata will be joining the mechanical engineering faculty at West Virginia University, and Dr. Jackson will be joining the University of Alabama (Tuscaloosa) as professor and head of aerospace engineering. In the Electrical and Computer Engineering Department, Dr. Yuan-Fang Zheng has left Clemson to join the faculty at Ohio State University. In the Environmental Systems Engineering Department, Prof. B. C. Dysart has accepted a position with industry after 22 years with Clemson University.

Some important changes in departmental administration have taken place. Dr. L. Wilson Pearson, principal scientist in electromagnetics at McDonnell Douglas Research Laboratories in St. Louis, has been appointed as professor and head of the Department of Electrical and Computer Engineering. Dr. Pearson received his doctoral degree in electrical engineering at the University of Illinois. He received his master’s degree in engineering science and his bachelor’s degree in electrical engineering from the University of Mississippi. Dr. John N. Gowdy, professor, had served as interim head.

Another department head vacancy was filled by Dr. Michael Leonard in the Industrial Engineering Department. Dr. Leonard received his B.I.E. and M.E. degrees in industrial engineering from the University of Florida, along with his Ph.D. degree in systems
engineering (operations research). Formerly the chairman of the Department of Industrial Engineering at the University of Missouri-Columbia, Dr. Leonard's fields of specialization include health care delivery, information and scheduling systems. He assumes the position that was held on an acting basis by Dr. Delbert Kimbler, professor of industrial engineering.

Faculty Honors and Awards

During the fiscal year 1989-90, the College of Engineering faculty have been honored with numerous awards in teaching, research, and public and professional service. The diversity of these awards is indicative of the wide range of talents faculty members possess in their areas of expertise.

Agricultural Engineering

- Darrell Roberts received the Packer Safety Engineering Award for 1988 from the American Society of Agricultural Engineers. This is the highest award given by the society for outstanding programs in safety-related subjects.
- Tom Garner received the Outstanding Teacher Award from the Clemson Chapter of Gamma Sigma Delta, which goes to the outstanding teacher in the Division of Agriculture and National Resources at Clemson University. He also received the NACTA Teaching Award.

Bioengineering

- The department chairman, Andreas F. von Recum, has been honored by the Academy of Surgical Research by devoting an issue of the *Journal of Investigative Surgery* to him as a Festschrift and by naming an annual award after him. Furthermore, he won a Fulbright Senior Scientist Award and was elected to receive an Alexander von Humboldt Senior U.S. Scientist Award for a one year research stay in Germany. Additionally, he was honored by the American Society for Engineering Education with the outstanding Biomedical Engineering Educator 1990 Award.

Chemical Engineering

- Mark C. Thies was selected by the national professional society to receive the award as the Outstanding Student Chapter Adviser of the American Institute of Chemical Engineers. This award, to be presented at the annual meeting of AIChE in Chicago during November, was made in recognition of his excellent leadership of of Clemson's student chapter over the past four years.
- Steve Melsheimer chaired the Steering Committee for the Southern Association of Colleges and Schools Self-Study.
- Joe Mullins chaired the University's internal investigation committee for the NCAA review of the football program.
Civil Engineering

- Earl J. Hayter received the Byars' Prize for Excellence in Teaching at the Honors and Awards Day ceremony March 31, 1990. The Byars' Prize was established to recognize outstanding teaching in engineering mechanics.

Electrical and Computer Engineering

- Chalmers M. Butler was one of three faculty selected to receive the National Cash Register Outstanding Faculty Award. This award is presented based on evaluations received from graduating senior exit interviews.
- James W. Harrison Jr. also received the NCR Outstanding Faculty Award.
- John J. Komo also received the NCR Outstanding Faculty Award as well as a Golden Apple Award, presented by Winn Dixie, Inc., and WYFF-TV. These awards are given to outstanding teachers nominated by parents, students or peers.
- Elliam B. Makram was awarded second place in the Research Paper Competition sponsored by the Southeastern Section of the American Society of Engineering Education (ASEE).
- Adly A. Girgis, professor, has received the Edison Electric Institute Educator of the Year Award.

Environmental Systems Engineering

- C.P. Leslie Grady was recognized in July 1989 by being conferred the Simon W. Freeze Environmental Engineering Award. This is the highest award given an environmental engineer by the American Society of Civil Engineers. Dr. Grady also delivered the keynote address at the society's annual conference in Texas.
- Alan W. Elzerman was elected chairman-elect of the ACS Division of Environmental Engineering Professors.
- Benjamin C. Dysart was elected secretary of the Executive Committee of The Rene Dubos Center for Human Environments.
- J. Charles Jennett, dean of the college and ESE professor, was named "Engineer of the Year" by the Piedmont Section of the South Carolina Society of Professional Engineers.
- Thomas M. Keinath, head, was elected president of the Association of Environmental Engineering Professors. He represents the environmental engineering faculty at more than 120 universities in North America.

Industrial Engineering

- Robert P. Davis and W.J. Kennedy were elected to the rank of Fellow in the Institute of Industrial Engineers. This is the highest rank in the institute, and is awarded for outstanding achievement over a long term of service to the profession.
- Delbert L. Kimbler received the Manufacturing Systems Award from the Institute of Industrial Engineers for service and achievement in manufacturing. He also served as president of the Society for Integrated Manufacturing of IIE.
• Bevlee A. Watford was named Young Engineer of the Year by the Piedmont Chapter of the South Carolina Society of Professional Engineers.

Mechanical Engineering

• James A. Liburdy, professor of mechanical engineering, was named the 1990 Sigma Xi Outstanding Research Scientist. The award is given annually to a member of the Clemson faculty who has achieved an outstanding record in a field of scientific research.

• James G. Goree, professor of mechanical engineering and engineering mechanics, was elected as the first Centennial Professor of Clemson University. The two-year professorship carries an annual stipend of $12,000 made possible by faculty contributions to an endowment established to recognize excellence in scholarship and professional achievement.

• Marvin W. Dixon, professor of mechanical engineering, received the Eugene H. Bishop Teaching Award. He was selected for this honor by the student members of Pi Tau Sigma, the Mechanical Engineering Honor Society. The award recognizes outstanding teaching in the Department of Mechanical Engineering.

• Cynthia C. Jara-Almonte, assistant professor of mechanical engineering, received the 1990 Ralph E. Teetor Educational Award. The award for younger engineering faculty emphasizes noteworthy contributions to classroom teaching, research and professional societies.

• Tah-teh Yang, professor of mechanical engineering, was appointed as a Fellow of the Strom Thurmond Institute. This appointment recognizes Dr. Yang’s contribution to the institute’s programs and to gas turbine technology. Dr. Yang also was elected vice-chairman of the Education Committee of the ASME Gas Turbine Division.

• Eugene H. Bishop, professor of mechanical engineering, was Clemson University’s nominee for the 1989 Governor’s Professor of the Year Award. He was named a Distinguished Professor of 1989, recognizing his exceptional teaching performance at Clemson University.

• Christian E. G. Przirembel, professor and head, was elected vice president for engineering education of the American Society of Mechanical Engineers. He currently represents the society on the Board of Directors of the Accreditation Board for Engineering and Technology. He also serves on the latter’s Executive Committee.

Student Awards and Recognition

Engineering students have come to not only reflect the excellence of the college, but they build upon that excellence every year. The 1989-90 was no exception in a year of student honors and recognition at regional and national levels, as well as at the University level. A partial list of these exemplary students follows:
Bioengineering

- Pamela A. Jacob received the Austin T. Moore Award for outstanding achievements in graduate studies in bioengineering. This award is given in memory of Austin T. Moore, M.D., pioneering orthopaedic surgeon and researcher. It is made possible by grants from the Moore Orthopaedic Clinic and Austin T. Moore Jr.’s Brace and Boot Orthopaedic Company, both in Columbia, S.C.

Ceramic Engineering

- Three ceramic engineering students have achieved self funding for their graduate programs.
- Shannon Namboodri also competed successfully for an NSF Innovative Fellowship Award and will enter graduate school at Virginia Tech.
- Matt Hooker ’89 won a NASA Graduate Fellowship. Matt will continue his studies at Clemson, working toward the Ph.D.
- Nettie Sweet, a rising senior in 1989, won a paper contest sponsored by the Consulting Engineers of South Carolina. This award included the 1989 CESC Scholarship Award.
- During the 1989-90 academic year, Paul Tennis, a rising senior, held the scholarship awarded by the National Institute of Ceramic Engineers.

Chemical Engineering

- Amy Elizabeth Harriman received the American Institute of Chemical Engineers Award, which is presented by the national professional society to the student in chemical engineering who has the highest cumulative grade point ratio at the end of the sophomore year.
- The C. E. Littlejohn Jr. Scholarship Award was presented to Ahmed Reda Bata.
- The Western South Carolina Section of AIChE Scholastic Achievement Award is presented by the local section of the chemical engineering professional society to the graduating senior who has the highest cumulative grade point ratio. This year’s recipient was Brian Todd Brandes, who also received the Dow Chemical Outstanding Junior Award.

Civil Engineering

- Laura Foster received the Institute of Transportation Engineers District 5 “Best Student Paper” Award.
- Salameh Nsour and Laura Cove each received fellowships from the Federal Highway Administration for conducting research studies in the Washington, D.C., area.
- The Clemson Chapter of the American Society of Civil Engineers hosted a conference, which involved 114 students from eight universities from the Southeast.
Electrical and Computer Engineering

- Michael Scott Buebel received the Piedmont Section IEEE Award, which is given to an outstanding junior in the ECE Department who exhibits the potential for success based on scholarship and leadership.
- India Elizabeth Vincent, Laurie Lee Joiner, Evan Howard Burnes and Jonathan Calvin White received the NCR Corporation Award, which recognizes sophomores and juniors for academic achievement.
- Jason Torrence Dowling received the ECE Hewlett-Packard Outstanding Junior Award in recognition of outstanding performance in classroom and laboratory work.
- Robert Collier, Joseph Michael Ingino and Dean Edward Merritt received the S. R. Rhodes Award; Lisa Ann Pickelsimer received the W. M. Riggs Award.
- The R. N. Kersey Award was given to Deborah Lynn Russell, who also received the J. Wesley Davis Leadership Award; the R. Kevin Black Junior Award for Excellence in Computer Engineering was awarded to John Ross George.

Environmental Systems Engineering

- Meredith Newman, Charles Shorten and Geoffrey Germann were recognized by the American Chemical Society with Student Paper Awards for outstanding presentations. Similarly, David Travis received the Health Physics Society’s Student Paper Award.
- Eric Wahlberg was selected for the Water Pollution Control Federation’s Robert A. Canham Fellowship to study at the United Kingdom’s Water Research Center in Stevenage, England.

Industrial Engineering

- The University Chapter of the Institute of Industrial Engineers received its fourth consecutive Award of Excellence. This award is part of a national competition and is presented based on the breadth and quality of the student professional activities.
- A local chapter of Alpha Pi Mu, the industrial Engineering Honor Society, was formed and chartered by the national organization this past spring. Several students were initiated, and Dr. James A. Chisman was initiated as a faculty member of the society in a ceremony conducted at the University of Tennessee Chapter.

Mechanical Engineering

- Under the able guidance of Dr. Cynthia C. Jara-Almonte, assistant professor of mechanical engineering, the Clemson student section of the Society of Women Engineers was elected as the “Most Improved Section in Region D,” which encompasses most of the Southeast.
- Colleen M. Wiggins, junior in mechanical engineering, was selected for the David Sarnoff Research Center Scholarship by the Society of Women Engineers. She has a perfect 4.0 grade point ratio and is an active leader in the student section.
The following students successfully completed their Senior Departmental Honors Program under the auspices of Calhoun College: Russell T. Allen, Brian K. Blair, J. Eric Bowman, Timothy A. Conover, C. Keith Downs and Ricardo P. Masalleras. Each student conducted a research program with the guidance of a faculty member, wrote a senior thesis and successfully defended the thesis.

Richard K. Wolterman was selected for an Alumni Fellowship. He also holds an NSF Fellowship.

R.C. Edwards Fellowships were awarded to: J. Randall Hall Jr., F. Jeffrey Keller, Charles Kirschman and T. Sue Shields.

Chettoor G. Namboodri Jr. received a Phi Kappa Phi Award that recognizes the graduating student(s) with the highest grade point ratio.

Cynthia D. Conway was selected for the College of Engineering Blue Key Academic and Leadership Award.

Emily C. Tedrow received the Hoechst-Celanese Undergraduate Honors Award, while Junghsen Leih and C. Chesley Rowe received the Hoechst-Celanese Graduate Awards.

Instruction

The College of Engineering is one of the largest academic units on campus in terms of enrollment and degrees granted. As reported earlier, total enrollment for the college was 3,150 for fall 1988, making the college the second largest in terms of enrollment. Between July 1, 1989, and June 30, 1990, the college awarded 415 baccalaureate degrees, 145 master’s degrees and 21 doctoral degrees.

On the University level, the College of Engineering has assumed a leadership role in the development and implementation of a new interdisciplinary graduate program in materials science and engineering. A formal proposal to the South Carolina Commission on Higher Education will be submitted in September 1990. The program will draw on the existing expertise in materials in the College of Engineering, the College of Sciences and the College of Commerce and Industry. Faculty from other units also will be invited to participate.

To meet the ever-changing needs of the outside technical world, the departments and research centers continue to keep their instructional programs up-to-date through expanding and revising their courses and goals. One example was the Department of Mechanical Engineering’s revision of its curriculum.

The faculty of the Department of Mechanical Engineering began to implement a revised undergraduate program, which has been developed over the last several years. A major element of the new program is the integration of engineering materials, engineering design and manufacturing. Three faculty members have participated in the MIT summer faculty program on “Introduction to Manufacturing” and brought the new viewpoints on concurrent engineering into the curriculum deliberations. The new curriculum also has strengthened the design experience by requiring a new thermal/fluid design course. The faculty members also have begun to look at the pedagogical aspects of developing the critical thinking skills of the students.
Other important events included the Department of Industrial Engineering receiving its initial accreditation from the Accreditation Board for Engineering and Technology (ABET). This was a major milestone in the department's growth. The department began operation with a small nucleus of faculty and students in 1983 and has now grown to approximately 200 students (undergraduate and graduate) and nine faculty. Further development of instructional laboratories began in 1990 with construction of a flexible manufacturing cell, which will support undergraduate and graduate course work.

The 1989-90 years were significant for the Agricultural Engineering Department in the strides that were made in its educational responsibilities. The department is unique among the departments in the College of Engineering in that it is jointly administered by the College of Engineering and the College of Agricultural Sciences. The faculty continued with the curriculum revision efforts that were started in 1987, culminating in the introduction of a new curriculum in the fall of 1989. The curriculum will have more emphasis on solving engineering problems as they relate to biological systems. In the past there has been a strong orientation to production agriculture, while the planned curriculum will be more oriented to the processing, storage and transportation of biological products. The students will be able to choose one of four emphasis areas: natural resources engineering, food engineering, biotechnology engineering and agricultural production/consumer products.

Another re-focusing of departmental teaching occurred within bioengineering. The faculty had made a firm commitment to narrow the departmental teaching and research focus down to biomaterials science and engineering. Subsequently, four faculty positions were filled with training and/or experience in biomaterials.

A new facet of civil engineering was inaugurated with a new program director and associate professor, Dr. James K. Nelson, at the Master of Engineering Program at The Citadel. Courses are offered by the program director, by adjunct faculty and through Telecampus. Presently the degree is limited to civil engineering, although discussions are under way to broaden the scope of the program to other engineering disciplines.

The Freshmen Engineering Program continues to have the largest number of students enrolled — 1,569 — compared to any other department on campus. Eight hundred eleven of these students are new freshmen, 112 are transfer students, 26 are former students returning to campus and 620 are continuing students. A second counselor, Eva McLeod, was hired to help advise student. Presently, the program also has one faculty member and the director to teach the two freshmen engineering courses and advise students. Permission to search for a second faculty member has been received, and the search started. The number of students seeking help from the faculty and counselors has continued to increase, a sign that the program is fulfilling one of its missions.

The program is designed to allow new students a year to decide on their engineering major. During this year, the students hear presentations by department heads about the engineering disciplines offered at Clemson and are given the opportunity to learn more about engineering at engineering student chapter meetings. Also, the students are given the opportunity to remove any academic deficiencies before they start their engineering career study. Those students who decide not to continue studying engineering may transfer from freshmen engineering to any other major without losing course credits. These features make the program attractive when recruiting students.
Dr. Robert W. Snelsire, founding director of the Minority Engineering Program, reports that the innovative program continues to successfully enroll and graduate minority engineering students. The program consists of two parts: PEER (Program for Engineering Enrichment and Retention), a peer-mentoring program designed to help freshman and sophomore minority engineering students, and the Industrial Associates Scholarships for minority students enrolled in engineering.

Perhaps the most outstanding feature of the Minority Engineering Program, PEER provides all minority freshmen (optional for sophomores) with a small network of peers to study and become friends with, under the experienced and friendly guidance of a minority junior, senior or graduate student mentor.

Research on study habits of all college students indicates that group study results in higher grades and better retention than studying alone. Research also shows that minority students, in particular, tend to study alone. They are hesitant to let their professors and peers know if they are having academic difficulties. PEER enables minority students to replace their former habits with new, proven study techniques.

After PEER's first year (1987-88), student retention statistics reflect its effectiveness: 73 percent of the freshmen returned to study engineering as sophomores.

By the fall of 1989, it became apparent that minority upperclassmen have unique needs not met by the existing structure of PEER. Specifically, juniors and seniors need mentoring from professors and minority professionals in industry.

To meet this need, Susan J. S. Lasser, a professional counselor, established Pre-Professional PEER (P3). Regular meetings and social events brought together minority engineers from local industries with Clemson's minority engineering students.

Linda Law, development coordinator for the program, reports that 25 companies contributed to the program, some for the first time.

The next phase of service to minority students will be the addition of a technical library/study area requested by the students. Recognizing the value of group study, those who benefited from PEER have demonstrated the need for a gathering place equipped with technical resources and personal computers.

Another important program in the instructional area of the college is the Engineering Graphics Program. Primarily a service program to the degree-granting departments in the College of Engineering, the program's goals are to develop the student's visualization capability and skills in graphic communication. Experience is provided by using the traditional graphics tools as well as computer graphics.

In a related area, significant progress was made this year in providing computing support facilities in Earle Hall for use by chemical engineering students. The department installed a Macintosh laboratory consisting of nine Mac SE computers networked to a pair of printers. Across the hall, four Sun Workstations were installed in another room, which also houses four terminals to the University mainframe computer and two Lanier AT computers. Near the end of the year, facilities were installed to allow all of the computers in Earle Hall to be networked to the University's VAX system and to the mainframe computer.
Research

Research is of fundamental importance to the College of Engineering. In addition to supporting graduate students, externally funded research provides a means for faculty to stay at the cutting edge of science and technology. As a leader in engineering research, the college’s essential goals have remained constant through the years: to seek new knowledge; to seek solutions to both the short- and long-term technological problems of the state and nation; and to support advanced-level educational programs by providing significant research experiences for students.

The level of research activity in the college continues to grow at a phenomenal rate. In the last six years, research awards have gone from $3.5 million to $10 million in 1989-90. The college logged more than $17 million of funded grants and contracts-in-force for the 1989-90 fiscal year. During this past year, 121 faculty were engaged in research supported by 303 graduate students, 137 undergraduates and 21 staff members (temporary and permanent) and visiting scholars.

Research Highlights

In the Bioengineering Department, Dr. Larry Dooley won major research contracts with an orthopaedic implant company (Howmedica) and a European research foundation (Muller Foundation, Switzerland) to develop an implant design/selection program for orthopaedic surgeons and computer based central register for implant documentation, respectively. Additionally, the S.C. based Fullerton Foundation committed one-third of one million dollars to these developments over a three-year period. By drawing attention to the potential hazards associated with high surface area CoCr alloy implants, Dr. Black has stimulated a new international interest in studying total patient outcome after orthopaedic implant procedures. Dr. A. von Recum reported on his findings that surface texture of biomaterials can improve their biocompatibility many fold. The potentials of this discovery for the implant manufacturer may be significant. Dr. Heimke, in conjunction with surgeons at the Shriner’s Hospital for Crippled Children in Greenville, developed a new implant for amputees that allows the direct attachment of prosthetic arms or legs to the skeleton. Initial animal tests are promising. Dr. Powers has been successful in providing continuing education courses to project engineers in the medical implant industry. His courses provide hands-on experience in implant evaluation and testing.

The momentum developed in the Chemical Engineering Department’s research programs was maintained as the level of grants-in-force in the department exceeded $1,356,800. The research expenditures were over $710,100 for the year, and the total amount authorized for new grants was $482,246. Some of the areas of research concentration in the department are supercritical extraction, stereolithography, membrane separations, the spinning of carbon fibers and the properties of the fibers and their composites, and process simulation and control.

Within the Department of Industrial Engineering, Dr. Bevlee A. Watford continues her work in applications of artificial intelligence in manufacturing. A recently completed project in computer simulation, sponsored by General Electric, involved a graduate intern working in the company’s plant in Greenville. A similar intern project in quality engineering with Torrington Co. is being supervised by Dr. W. J. Kennedy.
Quality and design are receiving major emphasis in the department, involving projects sponsored by the National Science Foundation (Dr. Robert P. Davis is the investigator) and Ingersoll-Rand (conducted by Dr. Delbert L. Kimbler and Dr. Joel S. Greenstein). These projects and continuing unsponsored work aim at integrating quality and design into manufacturing processes.

The Ceramic Engineering Department received $490,723 of outside funding during the 1989-90 fiscal year for research.

In the Electrical and Computer Engineering Department, Ronnie E. Owens was granted a Provost Research Award. He also received a $50,000 equipment grant from Hewlett Packard.

Agricultural extension engineers have been conducting five energy demonstrations and education programs ($280,000) that are being sponsored from the South Carolina Petroleum Violation Escrow Finds. The titles of these projects are: farm tractor efficiency, greenhouse energy audits, farm energy audits, irrigation pump efficiency tests, and fruit and vegetable cooling energy audits. These projects are conducted throughout the state to inform farmers and producers how to reduce energy use and thereby save money.

In the Civil Engineering Department, Dr. J. K. Nelson is working with the U.S. Navy on the development of an air launch free-fall boat. Also, Dr. S. D. Schiff is instrumenting railroad bridges in the field to determine the loading spectrum and response under actual field loading conditions.

Another civil engineering research project came to be an invaluable asset to the people of South Carolina. Through the direction of Drs. Ben Sill and Peter Sparks, the Coastal Hazards and Mitigation Project (CHAMP) lent its expertise in the wake of Hurricane Hugo. The professors assisted in the evaluation of building damages, informing municipalities and agencies on better building codes, and reporting to the state and nation on some of the reasons why much of the Hugo damage could have been avoided.

In the Electrical and Computer Engineering Department, several research projects brought new faces and continued support to the department. The Clemson University Electrical Power Research Association (CUEPRA), under the direction of Dr. Adly A. Girgis, continues to grow and now has seven industrial sponsors. Drs. David L. Lubkeman and Adly Girgis received a National Science Foundation grant to hold a workshop at Clemson entitled "Neural Network Methodology in Power Systems." This workshop brought some of the top researchers in neural networks to campus.

The Microstructures Laboratory continues to evolve under the leadership of Dr. Kelvin F. Poole, professor, and Dr. James Harriss, research associate, who joined the faculty in August 1989. The Semiconductor Research Corporation project received another renewal this year. This major project supports three faculty members and offers graduate students association with the Center for Semiconductor Device Reliability Research. Dr. Ward Morgan, who joined the faculty from Drexel University, has been named director for the Center for Computer Communication Systems. Dr. Morgan has been seeking industrial sponsors for this activity and is coordinating University faculty to perform research in this area.

This was a special year for the Mechanical Engineering Department. Dr. Irene Victorova, research scientist at the Mechanical Engineering Research Institute of the
Soviet Academy of Sciences, spent one month at Clemson delivering lectures and conducting research in the fracture mechanics of composite materials. Her visit was arranged by Dr. Goree under an agreement signed between the American Society of Mechanical Engineers and the U.S.S.R. Academy of Sciences. Dr. Victorova was the first person coming to the United States under this program. As a result of her visit, a formal exchange program is being developed between the Department of Mechanical Engineering at Clemson University and the Mechanical Engineering Research Institute.

In addition to this research exchange program, the department is conducting a research program on the enhancement of heat removal using pulsating water and air jets. The results of this investigation will significantly improve jet cooling, heating and drying technologies. The use of pulsating jets will lead to higher productivity and lower production costs in the manufacture of many commercial products, including metallic plates, textiles, paper and glass. Furthermore, pulsating jets may be suitable for heat removal from integrated circuits, permitting further miniaturization of electronic components.

A major research program being conducted by faculty in the Department of Mechanical Engineering addresses the need to apply flexible automation technology of robotics and computer workstation concepts for handling and manipulating fabric work-pieces in apparel manufacturing. The specific project is developing a robotic fabric handling system consisting of a general purpose industrial robot, a “smart” end effector (i.e., a robot hand instrumented with several types of sensors) and a high-speed vision control system to control the motions of the robot. This new technology will provide significant improvements in apparel manufacturing productivity through decreased time for work-in-progress.

Several ME faculty members are participants in the NIST Southeastern Manufacturing Technology Center, which is to enhance the productivity and technological performance in United States manufacturing. The center is to develop and/or transfer manufacturing technologies and processes to small and medium-sized companies. Clemson’s area of research is in the finishing and polishing of machined parts. Automated fabrication and inspection processes are being developed.

A NASA-sponsored research program on developing techniques to interpolate and approximate large volumes of randomly sampled variables is under way in the Department of Mechanical Engineering. Specific data sets are being generated from turbulent flow experiments utilizing far-field holography and an orthogonal stereoscopic method. Data acquisition relies on digital image processing techniques. Data analysis consists of the distribution of velocity, vorticity, Reynolds stresses and spectrum analyses. The results of this research program will substantially improve the quantity and quality of data obtained in the detailed study of flow fields using non-intrusive measurement techniques.

**Research Centers**

Most research in the college is funded through faculty working in one of the nine departments. However, the increased emphasis in interdisciplinary research has lead faculty to form groups focusing on a specific area of research. As a result, there are a number of interdisciplinary research programs under way in the College of Engineering. These programs include: the Center for Advanced Engineering Fibers and their Composites, the Center for Advanced Manufacturing, the Center for Computer Communication
systems, the Center for Engineering Ceramic Manufacturing, the Center for Semiconductor Device Reliability Research, the Bioengineering Alliance, the Energy Research Development Center, the Water Resources Research Institute, the Clemson University Electrical Power Research Alliance and the Construction Industry Cooperative Alliance, along with the recently CHE-approved Institute for Advanced Materials and Manufacturing.

Within the Water Resources Research Institute, six research projects were funded under the Section 104 Program during 1989-90. Some of the WRRI projects included: research into the behavior of a hydrocarbon spilled onto soils to determine if the residual hydrocarbon can be translocated by infiltrating water within the unsaturated zone; research to determine the effectiveness of vapor-phase transport to the atmosphere to remove volatile hydrocarbons; research on PCBs, specifically on the development of necessary analytical techniques, determination of the sources and present distribution of PCBs in Lake Hartwell; and development of fundamental mechanistic information on processes affecting PCBs in the reservoir. Ten master’s students and six Ph.D. students worked on these six projects. Publications resulting from the research projects include one Ph.D. dissertation, one M.S. thesis (six in preparation), one peer-reviewed journal paper (three in preparation) and eight conference proceeding papers.

During 1989-90 the South Carolina Energy Research and Development Center, a state agency administered by the University, continued funding competitive grant projects at the University of South Carolina and Clemson University. However, it expanded its role to include hosting a Symposium on Energy Futures, which attracted a nationwide audience and will become an annual event. The Energy Center also initiated two interest groups. What began as a superconductivity briefing session blossomed into an interest group and is presently a superconductivity consortium for the state of South Carolina. Also, because of South Carolina’s heavy involvement in the nuclear industry, an interest group has been initiated in nuclear maintenance.

The Center for Engineering Ceramic Manufacturing, under the direction of Dr. Denis Brosnan, received a record $84,000 in industrial research funding. The center also established a Whitewares and Refractories Division to operate in parallel with the Structural Clay Products Division.

The two-day annual research review of the Center for Semiconductor Device Reliability Research was attended by 18 members from the semiconductor industry. The six faculty and 10 graduate students working in the center were supported by $350,000 in grants, aid and contracts in 1989-90.

Books Published and Related Activities

Clemson’s engineering faculty continue to be actively engaged in the publication of informative texts on diverse topics. Many faculty members publish journal articles, conference proceedings and technical papers, and serve as editors or on editorial boards of professional journals. Some of the books published by the faculty during 1989-90 as well as professors serving as editors of journals (who have not been previously mentioned) include:

In the Electrical and Computer Engineering Department, Dr. Chalmers M. Butler was an associate editor of *Electromagnetics* and served on the editorial board of *Applied Computational Electromagnetics*. Johnson Y. S. Luh was an associate editor of the IEEE Transactions on *Robotics and Automation*. Dr. Robert J. Schalkoff was an associate editor of *Image and Vision Computing* and wrote a textbook on artificial intelligence.

Drs. B.C. Dysart and M. Clawson were editors of *Public Interest in the Use of Private Lands* and *Managing Public Lands in the Public Interest*, both published by Praeger Publishers.

Dr. Gene H. Haertling is serving as associate editor of the *Journal of The American Ceramic Society*.

**Public Service**

Continuing Engineering Education (CEE) is the primary public service activity of the College of Engineering. In an era of increasing foreign competition and technological change, participating engineers must continue their education to remain competitive. CEE provides a program of seminars, short courses and workshops designed to make the most effective use of the time that industry, government and consulting practice can allot to technical training. CEE also develops and sponsors conferences of one day to one week duration that promote technology transfer in a number of emerging technology areas. A summary of the 1989-90 program is shown below:

<table>
<thead>
<tr>
<th>Type of Offering</th>
<th>Number</th>
<th>Program-Days of Effort</th>
<th>Attendance</th>
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</thead>
<tbody>
<tr>
<td>Seminars, Workshops,</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Short Courses</td>
<td>35</td>
<td>84</td>
<td>844</td>
</tr>
<tr>
<td>Major Conferences</td>
<td>7</td>
<td>18</td>
<td>963</td>
</tr>
<tr>
<td>EIT/PE Reviews</td>
<td>153</td>
<td>153</td>
<td>3,080</td>
</tr>
<tr>
<td>In-House Seminars (for industry)</td>
<td>3</td>
<td>5</td>
<td>74</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>198</strong></td>
<td><strong>260</strong></td>
<td><strong>4,961</strong></td>
</tr>
</tbody>
</table>

Major conferences were sponsored in the areas of advanced engineering fibers, environmental law and technology, plant engineering and facilities maintenance, and biomedical engineering. CEE also sponsored the Annual S.C. Highway Conference in cooperation with the Civil Engineering Department.

CEE offered programs in seven different states during the year. These programs included a three-day course on heating and air-conditioning design that was offered publicly in six states; and a one-day course in new 530 Masonry Standards, offered at two South Carolina locations and a North Carolina site.
The number of engineers attending various courses in the CEE Professional Engineering (PE) Review Series held at a total attendance of just over 3,000. This series was offered in-house for Duke Power at Charlotte, N.C. The PE Review Series also was offered in Greenville in cooperation with the Piedmont Section of the National Society for Professional Engineers (NSPE). This year the series, sponsored by NSPE, also was made available to those engineers who had already been registered for several years, but who wished to be updated on new developments in their fields.

In-house programs delivered for industry continued during 1989-90, with four programs being presented. A major event in the in-house area was the delivery of a three-day course in electrical systems design for the U.S. Navy at its Southern Facilities Engineering Command in Charleston.

Joint ventures and cooperative arrangements expanded this year. CEE joined with the Greater Greenville Chamber of Commerce in sponsoring a conference on environmental law and technology, drawing 180 participants. CEE teamed with the S.C. Energy Research and Development Center to design, promote and hold the Symposium on Energy Futures. Additionally, CEE was joined with three technical associations in sponsorship of the 530 Masonry Standards course. Furthermore, CEE and Textile Hall Corporation co-sponsored the International Fiber Producer Conference and exhibition; the CEE conference was attended by 200 and the Textile Hall exhibition by 2,800.

In addition to new programs described previously, CEE sponsored offerings in total quality management in health care; mixing technologies for water and wastewater treatment; and a week-long program on statistical process control and design for quality.

In addition to CEE, other engineering departments host public service programs. During summer 1990, the Bioengineering Department conducted three workshops, “Bioengineers in Surgery.” These workshops were intended to prepare the industrial representative for interaction, in the operating room, with the surgeon and other members of the surgical team. The workshops consisted of a combination of formal lectures and actual surgical and histological exercises. Subjects covered include operating room conduct, sterile techniques, implantation procedures, surgical techniques, wound healing, biocompatibility and physician interactions.

Also, on March 30, 1990, the Department of Bioengineering sponsored the 1990 Hunter Honors Colloquium in Bioengineering. This year the conference was entitled “Ethical Issues at the Interface Between Engineering and Medicine.”

The Civil Engineering Department hosted its Transportation Technology Transfer Service (T3S), a federally and state funded public service activity directed toward education and training of employees of counties and municipalities. Currently in its third year of funding, T3S offered 20 workshops during 1989-90.

The Engineering Graphics Program conducted a workshop on “Computer Graphics in Undergraduate Engineering Design,” which was supported by the National Science Foundation at $54,186. Twenty-four members from universities around the country attended the workshop to learn about the latest computer graphics technology as related to design education. Professors Vera Anand, Nadim Aziz and Intiaz Haque conducted the workshop, with Professor Anand being the project director. The workshop was well received by the participants, and a 1991 workshop is being planned.
Another public service project was initiated by the Ceramic Engineering Department. Funded by the National Institute of Ceramic Engineers, an electronic entry level job service holds a database for recently graduated ceramic engineers looking for their first position all across the U.S.A. Employers access this database electronically through the department’s electronic bulletin board service. The department also continued to expand its public service component by adding a short course to the present group, which is repeated on an annual cycle and continues to enroll high numbers of participants.

COLLEGE OF FOREST AND RECREATION RESOURCES

The report of 1989-90 activities for the College of Forest and Recreation Resources’ resident instruction, research and Extension programs is included under the Division of Agriculture and Natural Resources on page 130.

COLLEGE OF LIBERAL ARTS

The College of Liberal Arts continues to subscribe to the notion that no university will achieve greatness without a strong program in the humanities, performing arts and social sciences. In addition, the college recognizes that a self-governing society requires of its citizens a basic and general education that will enable them, regardless of the career paths they follow, to lead full and useful lives, and to contribute to the general welfare of society.

On September 25, 1989, the college formally celebrated its 20th anniversary as a separate and independent academic unit at Clemson University with an afternoon panel discussion on the theory and practice of a liberal arts education and the role of the liberal arts today. The panelists, some of whom had earlier ties with the college, are recognized as leading educators in the liberal arts. Graham T. Allison, the author/editor of several major books on global politics, delivered the evening lecture, “Windows of Opportunity in U.S.—Soviet Relations.”

To provide its alumni with timely information about the college and its activities, the college published in the fall the first issue of its newsletter, Liberal Arts News, which carried a feature story on the growth of the college since its inception in 1969. Liberal Arts News is edited by a member of the English faculty and is published twice yearly.

Twelve percent of the undergraduates at the University major in the liberal arts, up from 7 percent just seven years ago. The faculty of the college teach approximately one quarter of the credit hours taken by students. Furthermore, of the thirty-eight semester hours needed to complete the University’s general education requirement, the college contributes nearly all of the courses for 21 of these hours.
The College of Liberal Arts consists of the departments of English, History, Languages, Performing Arts, Philosophy and Religion, Political Science, Psychology and Sociology. Except for Performing Arts, all departments offer majors leading to the Bachelor of Arts degree. English and History offer the Master of Arts degree, while Psychology offers the Master of Science degree in applied psychology.

More than 90 percent of the tenured and tenure-track Liberal Arts faculty hold the doctoral or other terminal degree. Graduates of the college enter some of the country's outstanding graduate and professional schools; many of the graduates pursue careers in business (including the service industries), industry and government upon earning their degrees from the University. During the year the college, along with each of its departments, prepared a unit self-study in anticipation of the reaccreditation visit from the Southern Association of Colleges and Schools. The college self-study of more than 100 pages was reviewed in the spring by an external group, the Liberal Arts Alumni Advisory Committee, at a meeting convened for that purpose and held at an off-campus location. The recommendations that will emerge in final form from the committee will be given serious consideration by the college.

Faculty Highlights

Three highly respected journals emanate from the College of Liberal Arts. The *South Carolina Review* is edited and published by faculty in the Department of English. This distinguished magazine, whose contributors have earned a number of awards, provides a forum for literary scholarship and criticism, as well as for outstanding poetry and short stories. With an international editorial board under the leadership of a faculty member in the Department of Political Science, *The Journal of Political Science* boasts a list of authors from leading colleges and universities from this country and from overseas. This journal emphasizes the scholarly contributions of younger researchers and addresses contemporary themes, evidenced by an issue this year devoted to "Governments-in-Exile." The Department of Languages edits and publishes *The Comparatist,* which is devoted to the literary and language interests of scholars in the Southeast and which is the official publication of the Southern Comparative Literature Association.

Liberal Arts faculty continue to be extremely active in scholarly and creative endeavors. They deliver papers at numerous regional, national, and international meetings and conferences; they contribute articles, poetry and fiction to a variety of established and influential journals; they edit book-length collections and prepare textbooks; they are active in musical and dramatic performances; and they write books that are issued by respected publishers and that receive favorable notices in the press.

An English faculty member was Clemson University's first recipient of the Class of '39 Faculty Award for Excellence.

In addition and as further acknowledgment of the recognition College of Liberal Arts faculty receive, they often hold positions as officers and as board members of professional organizations and societies. For example, a Political Science faculty member is chairman of the J. William Fulbright Foreign Scholarship Board and was a member of the first United States delegation to lecture at the Soviet Academy of Sciences. A Psychology faculty member was selected to attend the NATO conference held in Italy.
on aviation safety, while a Performing Arts faculty member chairs the Southeastern Theatre Conference New Play Project. Too, the faculty serve on editorial boards in their areas, as manuscript referees for publishers, and as evaluators of grant proposals.

Other departmental activities include, but are not limited to, the following: a Department of English book review service that specializes in children’s books; research conducted by the Department of Psychology in a variety of topics such as aging, industrial safety, stress management, computer-assisted instruction, artificial intelligence, consumer behavior, decision-making strategies, the development of pattern vision in children, eating disorders and substance abuse; and Department of Sociology research on police violence, parental grief, child abuse, children’s responses to crises, alcohol consumption, abortion, homelessness and the sociology of emotions.

Regular features of the College of Liberal Arts include gatherings of scholars and creative writers. For example, this year the college and the its Department of English co-sponsored with the Office of Human Resources the campus visit of Nikki Giovanni, noted black writer, who spoke before a large audience in Tillman Auditorium and who met with student creative writers. The Women’s Studies Colloquia sponsored three major lectures. The Department of Philosophy and Religion hosted a six-week National Endowment for the Humanities (NEH) Summer Institute, with the NEH Institute faculty also delivering a series of nine public lectures. This institute was the first of its kind to be held at Clemson. The Department of English hosted the Southern Circuit Film Series, which brought independent filmmakers to the campus to show and discuss their works. Through its Department of Psychology, the College of Liberal Arts co-sponsored a national conference on applied master’s degree programs in psychology held in Norman, Okla. This conference was attended by more than 60 department heads and graduate program directors representing universities in 26 states.

Public Service

The public service roles played by the College of Liberal Arts throughout the state and region continue to experience significant growth. Political Science faculty are frequently called upon by units of state and local government for advice on poll-taking, taxation and government organization. In addition, political scientists often serve as panelists for civic organizations and as consultants to both the print and electronic media on national and international affairs.

Sociologists contribute their expertise in such areas as the design and analysis of social surveys, leadership, the impact of industrial development on society, as well as in program development and evaluation in the fields of prison reform, spouse abuse, child custody, mental health, and alcohol and drug problems. Sociology faculty also offer workshops in staff growth and development for private and public service agencies. For example, two faculty members conducted leadership workshops in conjunction with a training contract awarded by the South Carolina Department of Social Services, while another has conducted workshops for educators in a school for abused, neglected and disadvantaged children. Psychologists continue to serve as consultants to the Southeastern Managers Network, an information-sharing organization of senior managers representing more than 20 area businesses and industrial concerns. Psycholo-
gists also continue to provide consultation on jury selection, eyewitness validation and expert witnesses on criminal sanity. Graduate students in the applied psychology program provide a wide spectrum of services, including training, personnel selection, job analysis and labor-management relations to area industry and businesses. English faculty conduct seminars and workshops in business and technical writing.

In addition to offering traditional language programs, the Department of Languages recognizes that it has a special mission in a world becoming more internationalized with each passing year. Given the large foreign investment in South Carolina industry and the need to develop overseas trade markets, the department’s language and international trade major, with a number of language and trade options, represents an apt response. The Department of Languages also sponsors an annual Language Declamation Contest, which drew more than 600 participants this year from South Carolina and nearby states. The department also conducted 1990 summer study programs in France, Germany and Mexico. More than 20 of its students studied abroad on internships or on grants.

Among the continued recipients of the college’s public service activities are the state’s schoolteachers. Improved civic education in the state’s public schools is the goal of the Thurmond Seminar, conducted by the Department of Political Science with funds from the Strom Thurmond Institute for Government and Public Affairs. Twenty social science teachers from the state’s secondary schools participated in this summer’s seminar, with classes held in Clemson and Washington, D.C. Liberal Arts faculty held summer institutes on campus for Advanced Placement (AP) teachers in European and United States history.

Together with the College of Education, the Department of English sponsored the eighth Summer Institute of the Clemson Writing Project. The Bread Loaf Rural Writing Network, Middlebury College’s Bread Loaf School of English, and Clemson’s Department of English continue their partnership in administering grants to teachers and students in several public schools in the state. Piloted by the Bread Loaf Rural Writing Network in South Carolina, Project REACH (Rural Education Alliance for Collaborative Humanities), which is funded by a Rockefeller Foundation grant channeled through the South Carolina Humanities Council, operates out of the Department of English.

Two new programs were created this year in response to the effects of Hurricane Hugo. In cooperation with the State Department of Education, REACH and the Bread Loaf Rural Writing Network sponsored “Project Hugo” — an appeal to schools for writing related to Hugo for eventual publication and distribution to school libraries. Another project, “Kids Talk from McClellanville,” a partnership of REACH, Bread Loaf Rural Writing Network, the Governor’s Office and Clemson’s Department of English, offered a four-week summer humanities and writing camp for young people in the area hardest hit by the storm.

With leadership provided by a faculty member in the Department of History, the Palmetto Humanities Program brings together faculty from different fields in the college to present programs for residents of the Keowee Key retirement community and of Hilton Head. History faculty served as graders for AP examinations in European history, while additional outreach activities include faculty from the Department of Performing Arts serving regularly as judges for music and theatre competitions in the region and state.
This year the College of Liberal Arts also sponsored the South Carolina School of Alcohol and Drug Studies, which operates out of the South Carolina Commission on Alcohol and Drugs. More than 500 students participated.

The College of Liberal Arts serves the entire student body of Clemson University in a variety of ways other than through direct classroom instruction. For example, the Model United Nations Program, sponsored by the Department of Political Science, annually competes in and has won awards at national conferences in Boston, New York, St. Louis and Washington. Clemson’s student representatives were selected as one of the eight distinguished delegations out of the 150 present this year at the Model United Nations held in New York City. Political Science also sponsors the State Student Legislature and the government internship program, the former involving an annual competition in Columbia and the latter involving students participating in local, state and national government. The Department of English operates the Writing Laboratory, which is available at no charge to all Clemson students with writing deficiencies.

The college also contributes to University life by supporting a number of student organizations and extracurricular activities. For example, Performing Arts oversees the Clemson Players, the student drama group which stages four plays during the academic year and two during summer school. Some of its productions have received regional and national recognition. Many musical activities are also under the direction of Performing Arts: the University Concert Series, Robert and Lillian Utsey Chamber Music Series, and student organizations including Tiger Band, Symphonic Band, University Chorus, Chamber Singers, C.U. After Six Singers and Jazz Ensemble. This year marked the debut of the C.U. Chamber Orchestra. The Department of English provides faculty advisers for two student publications: The Chronicle and The Tiger, the weekly student newspaper that has earned a number of collegiate awards.

Program Development

The new R. Roy and Margery W. Pearce Center for Professional Communication, made possible by a gift of $1,500,000, is dedicated to improving the total communication skills of students in all disciplines, and to providing assistance to the public schools and to the business and industrial communities.

The College of Liberal Arts Advisement Center, which began operation in the summer of 1988, has as its principal activity the academic advisement of nearly 300 undergraduates enrolled as liberal arts (undeclared) majors, a category designed for students who have not yet decided on a major area of study and are in the process of exploring academic options.

In conjunction with its freshman English program, the Department of English brings to campus each year a notable writer whose works are integrated into the basic composition course. This year Josephine Humphreys, author of Dreams of Sleep and Rich in Love, served in this capacity.

The language and international trade undergraduate major represents one of the significant bridges erected by the College of Liberal Arts to span the gap between the liberal arts and the scientific and technological disciplines on campus. This major joins Liberal Arts with the colleges of Agricultural Sciences, Commerce and Industry, and Forest and Recreation Resources in a successful interdisciplinary effort.
Another continuing and successful interdisciplinary endeavor, Communication Across the Curriculum, which is housed in the Department of English, involves all nine academic colleges in the communal goal of improving the writing skills of students.

The Department of Psychology's Master of Science degree in applied psychology, with tracks in both human factors and industrial/organizational psychology, has completed a successful second year. Its graduates are in demand by both regional and national companies. The Department of Sociology has applied to the Commission on Higher Education to offer a Master of Science degree in applied sociology.

Planning for the Student Performance Center continued with the completion of architectural drawings and the announcement of an anonymous gift of $1 million. Ground breaking is scheduled for the fall of 1990.

**COLLEGE OF NURSING**

The College of Nursing offers academic programs leading to the Bachelor of Science degree with a major in nursing and Master of Science degree with a major in nursing, as well as health courses available as a minor or as electives for non-nursing majors. During the 1989-90 academic year, these programs continued the growth begun in the previous year. Professional programs and health care services provided to both professional and lay public through the Nursing Center, the Continuing Education Program, the Wellness Program and Community Nursing Services continued to serve citizens of South Carolina. Significant strides were taken toward overall college development goals during the second year of development activity for the college.

**Administration**

Under the leadership of Dr. Opal Hipps, dean, the college is in the second year of implementation of a five-year plan that outlines specific goals for academic programs, research, service and development. Dr. Robbie Hughes, head of the Department of Instruction, is responsible for overseeing all academic offerings in the college. During the 1989-90 academic year, Dr. Katherine Nugent was appointed as assistant head of that department. Dr. Nugent is responsible for advisement, scheduling, the RN/BS/MS program and courses offered at outreach sites. Dr. Sara Barger administers the Department of Professional Services, which includes the Nursing Center, the University Wellness Program and Community Nursing Services. The Continuing Education Program, formerly a part of the Department of Professional Services, has recently been reestablished as a separate department within the college. A search is under way for an individual to serve as head of that department. Dr. Mary de Chesnay has completed her first year as head of the Department of Research, which under her leadership has expanded functions to focus research efforts and provide needed support for nursing research.

Support services for the college are under the direction of Dr. Pam Kline, associate dean. Areas of responsibility include management of college contracts with clinical agencies, student services such as recruitment, administration of scholarships, and
graduate traineeships and assistantships, as well as other related areas including the Media Resources Center.

The Development Office, under the direction of director Pat Padgett, has focused on scholarship development during fiscal year 1989-90. During the past year, the college has obtained new endowed programs for a total of $43,150, including donations from Anderson Memorial Hospital, Esther Brooks Moloney, the Fields and Campbell families in honor of Melanie Lane Fields, nursing alumni and members of Sigma Theta Tau, Gamma Mu Chapter. In addition, new annual programs totaling $13,300 have been established with the Edgar A. Brown Foundation, Humana Hospital Augusta, the Burns family and Richland Memorial Hospital.

A major corporate gift from Support Systems International was announced in May with the receipt of six Flexicare Model I-2000 beds and Clinisert systems mattresses and cushions. The beds were donated to augment student instruction in the Nursing Skills Laboratory. The gift has been valued at $195,270.

The combined total 1989-90 gifts for endowments, annual programs, gifts-in-kind and college advancement programs is $280,789, which represents a growth in activity of almost 60 percent over fiscal year 1988-89.

The College Development Board expanded to include the following members for 1989-90: George Bullwinkel, vice-president of customer relations, Southern Division of South Carolina Electric & Gas; Peggy Deane, vice-president for nursing of Anderson Memorial Hospital; Robert C. Edwards, president emeritus of Clemson University; William C. Kennerty, president of Kennerty Development, Incorporated; Russell McCall, vice-president of field operations of Support Systems International; and Carl S. Pulkinen, president of Corporate and Personal Planning, Incorporated. The Development Board’s support of college programs and activities is a vital link to the college.

Recent Developments, the College of Nursing newsletter, was published three times during the year for alumni and other friends. The newsletter highlights faculty, student and alumni accomplishments and keeps readers informed of new programs offered by the college. College support was also provided to alumni this year as they organized to form the Clemson Alumni Nursing Society.

Teaching

In the Department of Instruction, courses were offered for nursing majors in both the baccalaureate and master’s programs. Eighty students graduated from the undergraduate and graduate programs during 1989-90, an increase of 20 percent over the past year. Student enrollment during the past year included 310 undergraduate students and 75 graduate students.

Recruitment efforts have continued with excellent results. Although admission standards were raised for the 1990 nursing applicants, anticipated enrollment of freshmen and transfer students for fall 1990 is approximately 100, which is comparable to the 101 who enrolled in fall 1989. New graduate student enrollment for 1989 was 30, with a total graduate student enrollment of 75. These figures represent a significant increase over the fall 1988 enrollment of 57 students. Fall 1990 enrollment is expected to be comparable to that in 1989. Recruitment of minority students, including males, contin-
ues to be emphasized along with recruitment of traditional students in an intensified effort to meet the demand for more professional nurses. As a result of these efforts, enrollment of minority students has risen. In 1988, minority enrollment was 2 percent of the graduate program and 3 percent of the undergraduate program. In 1989, these figures rose to 5 percent for graduate students and 9 percent for undergraduate students.

A summer camp, the Heart of Health Summer Nursing Career Camp, supported by a contribution from Baptist Medical Center in Easley, was held this summer for the eighth year. Thirty-three high ability junior or senior high school students, 11 of whom were minorities, enrolled in the week-long experience. Participants were involved in activities designed to acquaint them with college life and nursing career opportunities. The camp has proven successful in encouraging students to consider Clemson as a college choice.

University approval has been obtained for an RN/BS/MS program of study designed for registered nurses who have graduated from associate degree programs. This curriculum allows registered nurses to enter as transfer students, with credit given for general education and support courses taken at any institution approved for transfer credit by the University. The curriculum focuses on courses in critical areas for the professional nurse, without duplication of previous course work. Initial response from the community has been enthusiastic, with preliminary enrollment projected at 15 students in the first year of implementation. This program should help address the shortage of master’s-prepared nurses in the state.

Televised instruction for graduate students has continued to be well received. During the past year, two graduate nursing courses were offered via Telecampus with 54 students enrolling. These figures represent a 19 percent increase in enrollment for Telecampus over the previous year. Additional offerings are slated for the 1990-91 year. These courses provide opportunities for nurses to continue graduate study in locations close to home or work, as do courses offered at the outreach site in the Greenville Higher Education Center.

The College of Nursing had its first international learning experiences during summer school 1990. Five graduate students and one undergraduate student spent one month in the Netherlands studying health care and health policy. They were accompanied by faculty member Jeri Milstead. During this same period, two Dutch nursing students came to South Carolina to enroll in Nursing 485, Nursing Extern Practicum, a senior clinical course offered in cooperation with the Greenville Hospital System. Students from Clemson who traveled to the Netherlands stayed in the dormitory of St. Elizabeth’s Hospital in Leiden, the agency which also sponsored the Dutch students who came to Clemson.

Participation in health courses has continued to increase, reflecting the growing public interest in health information and health consumerism. A total of 699 non-nursing majors enrolled in health courses during the year, representing a 100 percent increase in enrollment over the past year. The feasibility of offering a health major is currently being explored.

Overall faculty development in research, publications, scholarly presentations and academic preparation continues to demonstrate progress. Since 1989, the percent of faculty holding doctoral degrees has increased from 44 percent to 53 percent, with an additional 23 percent enrolled in doctoral study.
Research

During its first full year of operation with a permanent department head, the Department of Research has provided support to faculty and graduate students in terms of technical information on grants, methodological consultation, linking nurse researchers with potential co-investigators in other disciplines, financial support in the form of seed grants to five faculty (total $4,280) and partial summer salary to two faculty members to develop and refine grant proposals.

External funding exceeded $110,000 for two grants (National Institute of Health and March of Dimes). A Clemson University research grant ($3,000) was awarded to one faculty member for her research on high-risk infants. Two research proposals were submitted to NIH (approximately $600,000 total).

An important outreach objective was met in collaborative research networks. Negotiations are in progress with the Greenville Hospital System nurses for joint research with College of Nursing faculty. Four faculty members have begun collaborative projects with faculty in other disciplines.

The space allocated to faculty for working on research proposals has been redesigned and is being renovated to provide additional room for computers and small-group conferences. Computer access has been expanded with the addition of a director of informatics and a staff support person to assist college faculty and staff in maximizing the benefits of the computer hardware and software available.

The college’s rural health and international agendas were actively pursued with the submission of two rural health research grants (a center grant and a research project on the black elderly) and development of a plan to conduct research under the auspices of Clemson’s Archbold Tropical Center. Also, preliminary discussions were held with Secretary Elizabeth Dole’s office and with the health department to address the health needs of migrant workers.

Service

The Department of Professional Services, in addition to serving as a clinical site for student experiences and faculty research and practice, has the primary responsibility for implementing the service mission of the college through its Continuing Education Program, the Nursing Center, the University Wellness Program and Community Nursing Services.

The Continuing Education Program provided a total of 34 conferences for 1,384 nurses and other health professionals. These programs included a wide range of subjects which were well received by participants. An important milestone for the program was receiving reaccreditation as a continuing education provider by the American Nurses’ Association.

During 1989-90, 5,006 visits were made to the Nursing Center or to other sites for services provided by Nursing Center staff. Screenings were completed under the Early Periodic Screening, Diagnosis and Treatment Program (EPSDT) for Medicaid children; under the Women, Infants and Children Program (WIC); and for a variety of industrial, educational or service programs. This year 51 classes in cardiopulmonary resuscitation were conducted, training 397 people in CPR. Revenues increased by 15 percent this year.
The Wellness Program completed its first year under the leadership of its new director, Ron Alexander. His initial efforts centered around getting the program reestablished and recognized on campus since the program had been without a director for a year. As part of these activities, more than 25 wellness presentations were made by the director on campus to over 1,000 students and employees to promote the image of the Wellness Program and at the same time assist people in achieving a healthy lifestyle. Other activities include monthly "fun run/walks" offered on campus with more than 200 people participating, the fourth annual Wellness Challenge to encourage regular aerobic physical activity in students and employees, a flexibility program for employees in the maintenance shop to reduce back injuries, and a corporate wellness conference held in March as a cooperative effort between the Continuing Education Program and the Wellness Program.

The Community Nursing Services division received a certificate of need to provide home health services to residents within a 12-mile radius of Clemson University in February 1989. Licensure as a home health agency was received during that same month, followed by certification to receive third-party reimbursement in March 1990. Clemson University is the only academic institution who has received licensure to offer home health services. In addition to providing 24-hour-per-day coverage for home health services, services of a social worker and speech therapist are available through this program. In addition to providing an important service to homebound residents in the area, this program offers opportunities for enhanced practice and research for faculty, as well as educational opportunities for students.

Faculty Accomplishments

Outstanding faculty accomplishments include the following:

- Dr. Opal Hipps, dean and professor, was elected to a four-year term on the Executive Committee of the Council of Baccalaureate and Higher Degree Programs of the National League for Nursing. The primary purpose of this council is to support the development and improvement of baccalaureate and higher degree programs in nursing. A major function of the council is the development and review of the criteria and procedures for accreditation of member schools in accord with National League for Nursing policies and procedures. She was also selected for training as an accreditation site visitor for the NLN, along with Dr. Robbie Hughes, head of the Department of Instruction.

- Janet Timms, director of community nursing services, received the 1990 State Award for Excellence of the South Carolina Nurses Association. She was also recognized at the convention of the American Nurses Association in Boston in June.

- Dr. Sara Barger, head of the Department of Professional Services, was inducted as a Fellow of the American Academy of Nursing at the Academy’s annual meeting in Denver. The American Academy of Nursing is a group of about 500 scholars and statespersons who provide national leadership to guide the future of the nursing profession.
• Dr. Nancy Longcrier, director of nursing informatics, was selected to participate in the HBO & Company’s Nurse Scholars Program designed to demonstrate HBO & Company’s commitment to nursing education and to enhance the participants’ learning in the area of nursing informatics and hospital information systems.

**COLLEGE OF SCIENCES**

Research programs in the College of Sciences continued to increase at an annual funding rate of about 20 percent. Several prestigious national meetings and international science workshops were held on campus. Aggressive development continued in a number of specific research areas identified in the University’s strategic plan, such as biotechnology, astrophysics, materials science and instructional technology. The partnership between the Westinghouse Savannah River Site and the South Carolina Universities Research and Educational Foundation (SCUREF) has allowed the College of Sciences to collaborate with other colleges in undertaking challenging new initiatives in ecology, toxic waste management and ground-water geology. An affiliation now developing with the Greenville Hospital System also promises exciting opportunities for greatly expanded basic and applied research in biological sciences.

Dr. Philip Flower has published an introductory text. Dr. C.K. Revis-Wagner of the Biology Program and preprofessional health adviser was selected as Clemson’s Alumni Master Teacher. Dr. Joseph Manson was awarded a von Humboldt Fellowship for two years.

Clemson University, the first remote site to be chosen by ETS for expansion of its programs, was once again host to the Advanced Placement Readings run by the Educational Testing Service (ETS). Two chief readers and the director of the reading are College of Sciences faculty members.

After nationwide searches, Dr. Jack Lilien was selected to be head of the Department of Biological Sciences and Dr. John D. Petersen was selected to become head of the Department of Chemistry.

The Department of Earth Sciences received approval from the Commission on Higher Education to offer a master’s degree program emphasizing ground-water geology. A $50,000 gift from Bob and Betsy Campbell and a grant for an atomic absorption spectometer will be instrumental in getting this program off to a quick start. The Geology Museum has been under development and expansion to become a campus attraction.

Dean Bobby G. Wixson, who serves as chairman of the Society for Geochemistry and Health (SEGH) Task Force on recommending guidelines for lead in soils, met twice this year with this internationally recognized committee and prepared the draft report for external review and completion by December 1990. In February meetings were held with a visiting delegation to explore the possibility of establishing a branch campus in Kiryu City, Japan. Dr. Carlos Corredor, vice president of the Universidad del Valle in Cali, Colombia, also visited the College of Sciences to explore the possibility of joint research between the institutions.
In the realm of teaching, our faculty are meeting the requests for additional exposure to material with optional tutoring sessions and computer-assisted laboratories. New courses are being developed in all departments to reflect the changes in technology and focus. Calculus, statistics and linear algebra are being taught using “smart” calculators.

Department of Biological Sciences

The Department of Biological Sciences is now seven years old, and the number of undergraduates in its programs continues to increase, from 170 undergraduate majors in 1987 to more than 330 majors today. Expectations of these incoming students are different than those of students in the past. The new students are, in the main, not directed at the classical disciplines, for example zoology or botany, but at the modern fields which integrate knowledge from many of these classical fields. To accommodate these students, the department is developing a completely revised curriculum which focuses on modern areas of biology and synthesizes information from many originally separate disciplines. A core curriculum has been developed for majors of all interests, from the ecologically oriented to the most biochemically oriented. The core will include courses in ecology, cell biology, biochemistry and genetics to ensure that all graduates, regardless of specialization, will have a firm grounding in all aspects of biology. At a slightly more advanced level, new undergraduate and graduate courses are being developed in molecular genetics, emphasizing biotechnology and work with recombinant DNA. These courses are essential to meet the expectations of students and prepare them for the modern world.

The department is committed to the highest quality undergraduate instruction, and many of the faculty have spent a great deal of time organizing and developing new courses. Dr. James Zimmerman is a member of the American Society for Biochemistry and Molecular Biology committee on educational affairs. Dr. Ed Ruppert will soon complete a revised edition of the most popular undergraduate text in invertebrate zoology.

This increase in majors has put a tremendous stress on the faculty, support personnel and facilities. Classes are getting larger, and it is difficult to find adequate accommodations for them. In some cases it might be appropriate to split large classes into more than one section; however, neither the faculty nor support personnel are available to handle such classes.

Biological sciences graduate programs continue to support approximately 65 students earning degrees in biochemistry, botany and zoology, as well as a limited number of students earning degrees in the interdisciplinary plant physiology program. A new interdisciplinary graduate program in genetics is in the final stages of development, and the first stages in developing a new program in plant sciences have recently been initiated. The department will play a decisive role in each of these new programs. As the thrust of modern research changes and student interests adapt to these changes, instructional programs must also change to meet these new demands.

To meet the challenge of modern research, new facilities have been created to accommodate new technology. The recombinant DNA facility is now in the final stages of completion. In creating new facilities and focusing on common interest areas, faculty have been relocated closer to colleagues using a common equipment base or with a
common interest base. All of these moves and alterations have created chaos, but at the same time, they have created a feeling of optimism and progress. This renewed commitment to quality research also has put new stresses on support and clerical staff, who have been reorganized for more efficient operation.

Presently, faculty research programs are supported by 22 extramurally funded grants amounting to approximately $2 million in direct costs and approximately $1 million in indirect costs. Approximately 10 new grants are pending. Most of this support is through federal agencies (NSF, DOE, USDA and NIH); however, the department continues to accrue some support from industry and private sources. This emphasis on federal funding is expected to continue, in spite of the pessimistic budget forecasts, due in part to the department’s conscious emphasis on basic research. Five new federal grants recently have been awarded, including the award to John Wourms for deep submersible work in the Pacific Ocean and to Gary Powell for collaborative work with scientists in Germany.

Many faculty review proposals for various federal agencies. This is a singular honor as it signifies recognition in one’s field. However, with this honor comes the burden of extra work. Dr. David Heckel has been an ad hoc member of a USDA study section this year. Dr. Jack Lilien is a member of an NSF study section, and James Schindler is on leave to head a study section at NSF.

**Biology Program**

During the 1989-90 academic year, approximately 5,600 students were enrolled in courses in the Biology Program. Eleven lecture sections and 70 laboratory sections per week were taught each semester by faculty and graduate students from the Biology Program and departments of Microbiology and Biological Sciences. Summer programs included four update courses for precollege biology teachers in the areas of animal behavior, ecology, molecular genetics and video technologies.

Two faculty members conducted a workshop in the teaching of investigative laboratories, which was attended by 30 biologists from throughout the United States and Canada. Participants were selected from 150 applicants. The Eleventh Annual Clemson University Biology Merit Exam was conducted in April. Approximately 1,800 students and teachers attended.

One faculty member was selected as Clemson’s Alumni Master Teacher of the year. This award is given annually to the person recognized as Clemson’s outstanding teacher.

Several grants were awarded to faculty of the Biology Program during the 1988-89 academic year. These included a $60,000 Undergraduate Faculty Enhancement Grant from the National Science Foundation, a $100,000 Project Access Grant from the National Science Foundation, two grants totaling $45,000 to develop materials for the Center of Excellence in Science and Mathematics, a $200,000 Eisenhower Grant for the training of middle school science teachers, a $3,500 Provost Grant, a $58,000 Innovation Funds Grant and a $56,000 renewal of a grant from the United States Department of Education Fund for the Improvement of Post Secondary Education. Of 13 grant proposals submitted by the faculty, eight were funded and one is pending funding approval.
Scholarly activities carried on by the faculty included seven published manuscripts, four nationally published laboratory manuals, the authoring of a laser videotape, and the development of microcomputer programs and instructional videotapes. Twenty papers were presented by faculty at national and regional meetings, including the annual meetings of the National Association of Biology Teachers, National Science Teachers Association, the American Association for the Advancement of Science and the Association for Biology Laboratory Education. One faculty member continues to serve as chief reader for the Advanced Placement Program with the Educational Testing Service and taught eight national biology advanced placement workshops. Faculty also continue to serve as reviewers for NSF and New Jersey Educational Grants.

Department of Chemistry

The Department of Chemistry continues to be responsive to needs in all areas: undergraduate and graduate teaching, basic and applied chemical research, and service to the community and state.

The general chemistry program is a major part of the total effort of the department, serving more than 3,200 students per year for the third straight year. Changes are continuing to take place in the program to increase the success rate and to attract more interest in chemistry as a major and as a resource for students as informed citizens. Standard hourly exams and final exam are given to all students in a specific course, helping to make the grades uniform. Course instructors voluntarily provide a number of optional tutoring sessions. The Chemistry Help Center furnishes computer-assisted instruction to the students using IBM microcomputers supplied by the Computer Center. Dr. James Spain has developed a new instructional software package which takes advantage of student feedback. These programs received a student approval rating of over 95 percent in spring 1990. Through these efforts, the numbers of students failing general chemistry are continuing to be reduced.

Faculty and staff changes include:

• Dr. John Petersen took over on July 1 as head of the department.
• Dr. James C. Fanning returns to teaching and research after completing a productive year as acting head. He will be on sabbatical leave at UNC during the fall semester, returning to teaching and research in spring 1991.
• Dr. George Savitsky has retired, but continues to work with Dr. Spencer and others on research projects. Thus, the department soon will seek a replacement in physical chemistry. Dr. Danny Murphy will be a visiting professor for 1990-91 to pick up some of the load.
• Professor Knox Landers has yielded his role as adviser for registration and will be missed.
• Kimberli Lollis has taken on the second stockroom position, which adds considerably to the ability of the department to oversee the teaching laboratories.
• Dr. Melanie Cooper, director of undergraduate laboratories, continues to develop ways to improve the performance of teaching assistants. She has been named chairman of the University committee on TA preparation. Chemistry teaching
assistants (TAs) are graduate students who normally instruct three laboratory sections each week in general, organic, physical or analytical chemistry, each section having about 20 students. During the first week, the new TAs present a practice lecture on a basic chemical experiment. The lecture is videotaped and the results analyzed by the TA, Dr. Cooper and at least one other faculty member. If a TA does not perform satisfactorily, remedial work is required.

- Dr. Cooper also has moved to introduce "Writing Across the Curriculum" into the chemistry teaching programs. This program requires students to write more, even in large class sections, to improve overall communications ability.

The research program of the department continues to be impressive. Over the past year, 19 faculty members published 109 scientific journal articles and presented 80 papers at conferences and meetings. The faculty received new research grant and contract awards totaling $1.1 million. Thirty grants and contracts were managed during the year with a combined value of about $3 million. Research purchase expenditures for the year were slightly over $500,000, with the total departmental expenditures being $3 million.

Some of the young faculty members continue to make strong reputations in research and teaching. Drs. Joe Kolis, Ken Marcus and Greg Robinson are making an impact in all areas, including service to the department and community. Dr. Arkady Kholodenko is impressing the scientific community with his theoretical work. Dr. Edith Parsons has received three grants in her first year at Clemson and has actively sought undergraduate research participation, including bringing in undergraduates from other schools for summer research at Clemson. Dr. Muriel Bishop spent the 1989-90 academic year at the University of Georgia on an NSF research grant and will continue to work on that grant in conjunction with the University of Georgia.

A major service activity of the department for several years has been participation in the University's summer science camp. This brings approximately 250 children in grades 7 to 12 into the department for one to two weeks to discover some exciting chemistry concepts. The chemistry portion of the camp involves primarily laboratory work and is presently organized by Dr. Cooper. Seven chemistry faculty were involved with this program, which continues to grow.

Dr. Darryl D. DesMarteau, Tobey-Beaudrot professor of chemistry and former head, continues to lead the department to greater research activity by external funding for the 15 postdoctoral associates and graduate students in his group.

The department has introduced a new general chemistry series, introductory general and organic chemistry, to give a more qualitative and descriptive course for majors needing such a course, and to attract other students into chemistry as a science elective. Committees are being formed to review the entire undergraduate and graduate curriculum to develop sequences of courses that fit modern chemical practices while continuing to take care of a large number of other curricula in service courses.
The Department of Computer Science continued to grow stronger and move toward the establishment of a mature department with excellent research and instructional programs. This was the twelfth year of the department’s existence and the tenth year in which degree programs were offered.

The number of undergraduate majors remained at about 300 in the two B.S. programs. There were 52 B.S. graduates during the year, 18 in computer information systems and 34 in computer science. This is a decrease from 72 B.S. graduates produced last year and 94 in 1987-88, reflecting the decline in the number of majors that occurred nationally between 1982 and 1987.

The graduate program continues to grow stronger. During the past year there were about 110 graduate students, with 18 of these being Ph.D. students. There were 30 M.S. graduates during the year, up from 18 in the previous year. Two Ph.D. degrees in computer science were awarded.

Employment prospects continue to be excellent for our graduates. The demand for graduates appeared to exceed the supply by a large margin, and starting salaries were significantly higher. There has been a shift toward more emphasis on academic performance in selecting candidates for positions, however.

Externally funded research remains at about $1 million in annual expenditures. Good progress is being made in diversifying and expanding the research funding base. The department also continues to be quite successful in attracting equipment donations to support research and instruction. Donations this year exceeded $700,000 in total value and included computers from AT&T, Concurrent Computer Corporation and Sun Microsystems. Maintenance on computer equipment continues to be a problem, however, and the annual maintenance costs exceed the normal budget allocation by more than $20,000, which the department must generate from external sources.

Space continues to be a major problem for the department. The renovation of space in Jordan Hall has been a great help, but permanent office and laboratory space must be found to provide a reasonable “home” for the department. The temporary quarters in the Nursing Building have served the department well during its development, but there is not enough space in the building for both the department and the College of Nursing. Also, the building was not constructed with the needs of the department in mind. All available space is now filled, and there is no space for donated equipment or externally fund research projects.

The department was successful in attracting two new faculty members for 1989-90. This enviable record of faculty retention remains in danger as faculty discover they can easily find jobs at peer institutions at an increase of $5,000 to $10,000 in salary. Some progress was made in improving salaries the past few years as a result of the University’s salary adjustment efforts, but substantial additional efforts are still needed.

A third problem is recruiting high quality graduate students. Clemson is again unable to compete with the support levels offered by peer institutions. An increase in assistantship stipends and substantial fellowships is greatly needed.
Department of Earth Sciences

A significant milestone was reached this past year when the S.C. Commission on Higher Education approved on May 3, 1990, Clemson University’s proposal for an M.S. degree program in geology. The new graduate program will emphasize ground-water geology and is designed to meet a pressing demand for qualified hydrogeologists. This interdisciplinary program will involve faculty from the Department of Earth Sciences and the College of Engineering.

The Department of Earth Sciences received a $50,000 gift from Bob and Betsy Campbell to enhance the master’s program in ground-water geology. This gift will be used to purchase equipment for a field laboratory for ground-water research and education. The project will take advantage of two ideal field sites, one situated in the Coastal Plain near the center of the Savannah River Site (SRS) and the second in the Piedmont at the Clemson Research Watershed. The goal is to develop a nationally acclaimed field training program in ground-water geology. Additional funds at the SRS field site are being negotiated from SCUREF through an approved statement of need entitled “Establishment of a Field Geohydrology Experimental Site.”

Another major step forward for the geology program was the purchase of a state-of-the-art atomic absorption spectrometer. This was made possible by a $35,000 grant to Dr. Richard Warner from NSF’s Instrumentation for laboratory improvement program coupled with matching funds from the College of Sciences. This instrument will primarily be used to analyze ground-water.

Self-study of the Earth Sciences Department was completed during 1989-90. The major mission of the department was identified as “to train students in the fundamentals of geology, both theoretical and practical, leading to the Bachelor of Science and Bachelor of Arts degrees.” An important auxiliary is the teaching of introductory geology courses to Clemson undergraduates majoring in other disciplines. With approval of the geology M.S. program, an additional goal will be to prepare master’s candidates for professional employment in the ground-water industry. Expanding and improving research productivity, training and recertifying South Carolina earth science teachers in K-12 grades, and augmenting the public service role of the department were also cited in the self-study report as important components of the department’s mission.

As the Department of Earth Sciences moves to strengthen its existing baccalaureate programs and initiate a master’s program, several problems will be faced. One is the need for better equipment; most dire is the need to replace the antiquated X-ray diffractometer. Second, sufficient funds must be obtained to support graduate students at a regionally competitive stipend. Third, the department’s operating budget must increase substantially to cover additional costs in travel, supplies, library holdings, equipment maintenance, etc.

Noteworthy among individual accomplishments during 1989-90 was the awarding of a research grant to Dr. David Snipes ($89,846 over two years from Westinghouse Savannah River Company/Department of Energy to study the Pen Branch Fault at SRS) and a teaching grant to Dr. John Wagner ($38,867 from the S.C. Commission on Higher Education for “Preparing for Science in the 90s”). Two geology faculty members presented talks overseas: Dr. George Haselton at the Second International Conference
on Geomorphology in Frankfurt, Germany, and Dr. Richard Warner at the Sixth Scientific Assembly of the International Association of Geomagnetism and Aeronomy in Exeter, England. Finally, under the guidance of Mrs. Betty Newton, the Geology Museum in Brackett Hall has emerged as a major campus attraction, which during 1989-90 drew more than 1,400 visitors.

Department of Mathematical Sciences

The Department of Mathematical Sciences continued its strong commitment to teaching, not only by offering over one-eighth of the total credit hour production of the University, but by innovative new classroom techniques and formats. The department awarded 31 bachelor’s degrees, 30 master’s degrees and four Ph.D. degrees during the 12-month period. In addition, the faculty increased its national and international stature for scholarly endeavors, while at the same time serving professional organizations and Clemson University in a myriad of ways.

The department’s innovative teaching of calculus, statistics and linear algebra using "smart" calculators and microcomputers drew the attention of the national mathematical community. The project will be one of 10 highlighted in an upcoming publication from the Mathematical Association of America. Funded by both the U.S. Department of Education and NSF, the project has been well received by faculty and students at Clemson. In addition, plans are under way to develop a special statistics for engineers program, supported by a University innovation funds grant, and in conjunction with other major engineering schools. The new problem-solving course for math majors has exceeded expectations, while the graduate programs continue to be some of the most successful in the United States. These master’s and Ph.D programs draw students from all over the country, and they are among the best the nation has to offer; the year saw a record number of students pass the departmental doctoral exams.

The department’s commitment to teaching and teachers was evidenced by continued strong involvement in mathematics education. Through various state and national grants and contracts, the department has worked with mathematics teachers throughout the state. One important witness to that fact is the large NSF grant, joint with the Pickens County School District and a substantial contribution from NCR, which will result in up-to-the-minute computer/mathematics interface training for students and teachers throughout the district.

Although this year saw the end of a large ONR block grant, there was no decline in the research activity. Collectively, the faculty published in excess of 50 research papers in professional journals, submitted another 50 or so for future publication and gave numerous presentations at professional meetings. Several faculty members obtained new external funding, with grants coming from prestigious agencies such as the ONR, AFOSR and NIST. In addition, work has begun on modeling some environmental problems with the Savannah River Project, and some faculty have a research contract with an upstate corporation as well. Significant strides were made in upgrading computing facilities, including the purchase of Sun work stations for use by researchers needing high speed graphics. The department was pleased to initiate a Rotating Distinguished Professor series this year. Some of the world’s most highly regarded mathematical scientists in discrete mathematics and in applied analysis spent from one to four weeks each here.
Faculty continued to serve the University community. One faculty member has assumed responsibility as president elect of the Faculty Senate; another serves the University on the South Carolina EPSCOR committee; one chairs the college’s honors committee; and all remain active in curricular and computing committees. Nationally, members of the faculty serve on panels for the National Academy of Sciences, in high ranking positions with the College Board and on executive committees for two of the three national mathematics organizations. Furthermore, there are journal editors and journal board members among the Clemson math faculty.

The department’s self-study committee did a thorough job, and some of its assessment suggestions have begun to be implemented. Interviews were conducted with graduating bachelor’s, master’s and Ph.D. students before each of the three graduations this year. The department also devised special questions for the alumni survey.

Six faculty members were on leave during the school year involved in projects from England to Harvard, from von Humboldt fellows to scientists with the national Center for Disarmament. Seven new faculty members were added in the fall of 1989, including three women Ph.D.’s. The faculty also will increase in the fall of 1990 with the addition of one new tenure track position and two new lecturer positions. These additions will significantly increase the department’s ability to provide quality mathematics instruction for this University, as will a new format for freshman and sophomore courses, allowing for further supervision of any teaching assistants who work as classroom teachers.

Medical Technology Program

The Medical Technology Program completed another productive year of teaching, advising, administrative activity and club sponsorship. The program currently enrolls about 30 students. Nine entering freshmen and nine transfer or change-of-major students joined the medical technology curriculum. This was partially offset by five students transferring out of the program. In addition, five students completed the baccalaureate degree requirements for graduation. The senior clinical-year students continue to excel on the national certification exam. All have been successful in finding employment in the profession. With serious nationwide shortages in the profession, the number and range of professional opportunities is large.

Senior-year clinical courses continue to be offered by hospital program affiliates. Formal affiliation programs are with the schools of medical technology at Anderson Memorial Hospital in Anderson, S.C., and at McLeod Regional Medical Center in Florence, S.C. Informal affiliations exist with the medical technology programs at the Medical University of South Carolina in Charleston, S.C., and the Baptist Medical Center in Columbia, S.C. The Anderson program continues to help teach the introductory medical technology course taken by new majors.

With the advent of government restrictions limiting health-care reimbursements to hospitals and other providers, many hospital-based programs in health education need to develop additional sources of funding for fiscal stability. Through the Medical Technology Committee, the University has instituted a plan whereby Clemson University provides a significant amount of support to the Anderson Hospital School of
Medical Technology for each Clemson clinical student in attendance in return for a guarantee of eight places in the class. This agreement has been renewed for a second two-year period.

The current program coordinator continued to promote medical technology by group and individual presentations to students and teachers from around the state and by participation in the spring annual meeting of the S.C. Society for Medical Technology. The student Medical Technology Club completed another successful year of activities, including a trip to the Greenville Memorial Hospital Laboratory, presentations by speakers and service projects. The club has once again been funded by Student Government for the coming year.

Reports have been prepared by the program coordinator for the University’s current self-study, in preparation for the 10-year reaccreditation visit by SCAS and for the CHE program review conducted this year.

Department of Microbiology

Some 100 students were enrolled in the baccalaureate program, 21 in the M.S. and 16 in the Ph.D. At the end of the spring semester, 25 undergraduates were named to the Dean’s List and three to the President’s List. A graduate student received one of six travel awards from the American Society for Microbiology to attend the national annual meeting to present a research paper. A total of 17 B.S., four M.S. and three Ph.D. degrees were awarded. Baccalaureate graduates entered medical schools, graduate programs or positions with industries. The M.S. graduates continued in doctoral programs at various institutions, and the doctorates accepted postdoctoral positions at NIH and Johns Hopkins University.

Faculty were active in both basic and applied research projects. Grants and contracts were in force from NIH, USDA, Food Science Corp. and the U.S. Geological Survey. Some of the projects were: the microbial degradation of herbicides in anaerobic aquatic sediments; biological nitrogen fixation by a halotolerant bacterium that associates with seagrass plants; diseases of catfish and their immunological response; chemical stimulation of the immune response; the genetics and control of cellulase enzyme production; effective conversion of residual cellulose in extracted alfalfa to sugars; genetic engineering of rhizobia for improved biological nitrogen fixation; genetic engineering of lactic acid bacteria for improved food processing and production; hormonal control of DNA expression in mouse melanoma cells; regulation of procaryotic and eucaryotic DNA expression by low molecular weight metabolites; interactions of chemical carcinogens with repair of UV-damaged DNA; interaction between methanogenic and sulfidogenic bacteria; characteristics of the cellulase complex produced by a salt marsh bacterium; and studies on destruction of the immune defense system active against the bacterium that causes dental caries.

Faculty published 17 research articles in international professional journals and four book chapters, made 12 presentations at professional meetings and gave numerous invited seminars. A faculty member served as the North American editor for the Society for Applied Bacteriology and on the editorial board for the Journal of Industrial Microbiology. Another faculty member served as the councilor to the national organi-
zation for the South Carolina Branch of the American Society for Microbiology and as a reviewer of the eucaryotic molecular genetic program for NIH.

The department continued to play a lead role in the University’s biotechnology efforts. A number of molecular genetic/genetic engineering research projects were undertaken. Also, a USDA funded project was completed in collaboration with faculty in the College of Agricultural Sciences to assess risks associated with release of genetically engineered bacteria into soil. Dr. Kline was an invited contributor to the Agricultural Biotechnology Research Advisory Panel to the U.S. Government. This panel sets policy for the application and use of genetically engineered microbes in agriculture. He also served as chair of the review panel for EPA research regarding release of genetically engineered microbes to the environment. Microbiology faculty were central to development of the biotechnology thrust in food safety through microbiology. Dr. Paynter, in conjunction with BioConferences International, organized and participated in an international conference, “Bioprocess’ 90,” held in Washington, D.C.

A new cooperative research venture has been initiated with the Greenville Hospital System. This involves faculty, graduate students and physicians.

Department of Physics and Astronomy

The department was joined this year by Dr. Donald Clayton, who comes to Clemson from Rice University where he held the Andrew Hays Buchanan Chair in the Department of Space Physics. His research interests are nuclear astrophysics, gamma-ray astronomy and the origin of meteorites. His presence at Clemson has already brought visibility from the international space-physics community and has improved Clemson’s ability to recruit faculty in this area. Professor Clayton has recently been named a co-investigator on NASA’s Gamma Ray Observatory Satellite.

The department has been faced with the retirements of two faculty members who have had strong influences on the development of the department and its character: Professors Henry Vogel and E. P. Stillwell. Professor Henry Vogel has served on the faculty for 36 years, four years as department head and 16 years as dean of the College of Sciences. His tours as an administrator have included many changes in Clemson and in the department.

Professor Stillwell served on the faculty for 30 years, including three years as department head. He was one of the driving forces that built the department’s excellent reputation in condensed matter physics. He and Professor Malcolm Skove collaborated for many years in the area of charged density waves in superconducting fibers. Both faculty intend to continue their research in the department as emeritus professors in collaboration with Professor G. X. Tessema.

Meg Fox will be leaving the department after four years of keeping the books on departmental expenditures. Activity has tripled in volume during her tenure. She is being replaced by Diane Carey.

Two new faculty join the department this year. Dr. Dieter Hartmann arrives in September as assistant professor. Coming from Lawrence Livermore National Laboratory, Dr. Hartmann obtained his M.S. in physics at Gottingen University and his Ph.D. in astrophysics from the University of California, Santa Cruz. Dr. Bradley Meyer also
comes from Lawrence Livermore National Laboratory. He received his B.A. degree in physics from Rice University and his Ph.D. in astrophysics from the University of Chicago.

Two research associates/assistant professors were added this year. Wagih Abdel-Kader is working in radiation physics with Professor Peter McNulty. Lih-Sin The is working in gamma-ray astronomy with Professor Don Clayton.

Linda Westbrook joined the department this year as word processor specialist. She was previously working in International Programs.

Professor Phillip J. Flower completed an introductory textbook, *Understanding the Universe*, that has been published by West Publishing Company. It has been adopted for use in the introductory astronomy courses at Clemson as well as at a number of other colleges and universities.

Professor Lewis Duncan, associate dean for research, received an award for best paper in plasma physics from the Office of Naval Research. Professor Richard Manson received the Alexander von Humboldt Senior Scientist Award for 1990-92 and is conducting research this summer in both Germany and France.

Last year, following a substantial "Cutting Edge" award, department funding from external grants and contracts tripled to $757,126. This year it increased again slightly to $859,575 in expenditures for the year. External funding in this year’s budget includes: $85,000 from NRL, $38,464 from NASA and $5,722 from Rice University for Professor Donald Clayton; $153,350 from NASA and $25,000 from Los Alamos for Professor Lewis Duncan; $110,000 from NASA and $57,856 from the Air Force for Professor Miguel Larsen; $150,106 from DNA and $70,000 from the Air Force for Professor Pete McNulty; $44,000 from the Navy for Professor Lee Miller; $40,644 from NSF for Professors Ray Turner, John Gilreath and Max Miller; $4,000 from NASA for Professor Carl Ulbrich; and $75,433 from Duke Power for Professor Jim Eubanks.

Professor Robert M. Panoff, by invitation of the International Advisory Committee of the Conference on Recent Progress in Many-Body Physics, hosted the national encounter "Many-Body Physics: Where do we go from here?" in May at Clemson. This meeting was made possible by a $15,000 award from the Innovation Funds as well as corporate support from IBM, Cray and DEC.

Professor Peter J. McNulty, department head, was asked by the IEEE to organize and chair the short course "Microelectronics in the Natural Radiation Environments of Space" in Reno, Nev., in July. The short course is part of the Nuclear and Space Radiation Effects Conference, and Professor McNulty will serve on its organizing committee. Enrollment in the short course is projected to be a record 70 percent of the conference attendees. Professor McNulty also will present one of the tutorials, "Predicting Single Event Phenomena." The text of all the presentations is being published and distributed. The projected enrollment of 500 students is expected to generate $100,000 of tuition for the society.

Professor D. P. Miller was on sabbatical at the Centre de Recherche sur les Macromoles Vegetales, CNRS, in Grenoble, France, in the fall and again in May and June. Professor H. W. Graben was on sabbatical to Ireland during the spring at the Institute for Advanced Studies in Dublin and the University of Galway. Professor Miguel Larsen was on leave in Japan. He spent the spring semester at the Radio Atmospheric Science
Center at Kyoto University. Professor Keller will be going on sabbatical in the fall of 1990-91.

Most important of all, the department awarded four B.S. degrees in physics, 10 M.S. degrees and four Ph.D. degrees.

The department held its annual Physics Day in November. It was organized again by Professor Tom Collins and was the most successful ever. Forty high schools were represented, with more than 1,200 students attending. Students attended lectures and demonstrations by Professors Ray Turner, Dick Manson, John Gilreath, Bob Panoff, Henry Vogel and Don Miller. High school teachers and counselors met with Professors Gilreath and McNulty over coffee. This program is expected to significantly impact recruiting in both engineering and sciences at Clemson.

Provost Awards were received this year by Professors Ray Turner and G.X. Tessema. Professor Phil Burt received a travel award for research. Professor Bob Panoff received a University Research Grant award and obtained 300 hours of supercomputer time from NSF and DOE.

DIVISION OF AGRICULTURE AND NATURAL RESOURCES

The Division of Agriculture and Natural Resources is responsible for instructional, research and public service programs in the College of Agricultural Sciences and the College of Forest and Recreation Resources.

In addition to its programs for resident instruction, the College of Agricultural Sciences administers statewide public service programs that serve businesses, industry and virtually every citizen of the state. These public service functions include administration and coordination of the S.C. Agricultural Experiment Station, the Clemson Cooperative Extension Service, the Division of Regulatory and Public Service Programs and the Livestock-Poultry Health Department.

The scope of the College of Forest and Recreation Resources’ programs also spans the entire state and touches the lives of all South Carolinians through teaching, research and Extension activities in forest management, wood utilization, recreation resources and services, and tourism management.

Since their inception, the agriculture divisions and their leaders have emphasized agricultural production and improved family life, thus laying a strong foundation for the future. As we have celebrated the University’s second century, our objectives have been to increase productivity, increase employment opportunities, and conserve and protect our natural resources.

A series of statewide meetings to seek advice from the public was a significant highlight this year in the division. The Agriculture and Natural Resources Committee of Clemson’s Board of Trustees and the Division’s administrative officers served as a sounding board at these meetings where citizens voiced their opinions of Clemson’s public service programs. This input from the grassroots level was valuable and is already helping the division shape its goals for the future.
The division was exceptionally proud of the service it provided in the aftermath of Hurricane Hugo, a storm which victimized the people of a large area of the state and caused severe damage to agriculture and natural resources. The Clemson Extension Service responded quickly by assessing damage, producing emergency information sheets, assisting FEMA, furnishing food and other necessary supplies, and finding electrical generators for farmers.

Research had an exciting year with the addition of the wildlife and environmental toxicology program, while the food packaging program attracted state, national and international interest with the development of an edible packaging film.

The Livestock and Poultry Health Program added new testing systems for swine brucellosis at individual farms and at commercial slaughter facilities, and the Regulatory and Public Service Program began assembling information on how to handle the Africanized bee situation well in advance of the bees' arrival.

More detailed reports of each of the divisions follow.

COLLEGE OF AGRICULTURAL SCIENCES

Academic Affairs

Dr. T. Ross Wilkinson assumed the responsibilities of dean and director of resident instruction in October 1989. Due to the scope of the responsibilities of the office, the title of the position was changed to dean of academic affairs. Dr. Wilkinson brings 20 years of experience in higher education to this position, including 11 years in classroom and laboratory instruction, 15 years in research and 14 years in administration. This latter experience included positions as department head, associate dean of agriculture and research director of a biotechnology center.

Under Wilkinson's leadership, the college plans to build upon its rich academic tradition in addressing the educational needs of the people in South Carolina and the expertise demands of the diverse agricultural industry. The college will focus on attracting quality students into the various career tracts available in the agricultural industry. In the fall of 1989, freshman enrollment in the college increased over 100 percent compared to the previous year. Continued enrollment increase is expected.

An aggressive recruitment effort has been undertaken. Kirby Player was hired as coordinator of student relations and recruitment. The goal of this office will be to conduct programs and produce information that will inform students, parents and educators about the varied career opportunities in today's modern agriculture. A special project has been initiated to attract, retain and place minorities in agricultural careers. Funds for recruiting scholarships are being identified to attract high quality students with diverse backgrounds and interests. Human resource is one of the most critical needs in today's industry.

Academic programs will be continually developed and redefined to provide cutting-edge educational opportunities. Current technologies in instruction, such as sattelite networking, Telecampus and foreign exchange programs, will be incorporated with the
traditional classroom and laboratory instruction. The goal of the college is to graduate a well-educated individual who will benefit not only agriculture, but society in general.

Improvements in classroom facilities are under way to provide an environment conducive to learning. Eight lecture rooms are being renovated in time for fall classes. Changes in lighting, seating arrangements, audio-visual resources and computer equipment are being made, along with providing a study lounge for students.

Faculty have been intensely involved in evaluating the various programs within the college and in developing a strategic plan for agriculture's future. Benchmarks have been identified to assess the quality of the undergraduate and graduate academic programs. The Strategic Planning Committee in Agriculture recommended emphases in the following areas: conservation and protection of the environment; development of basic information and technology; globalization and changing structure of agriculture; food quality and processing; and human capital.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION

The South Carolina Agricultural Experiment Station at Clemson conducts the state's only state-funded agricultural research program. Scientists in 12 departments of the College of Agricultural Sciences provide expertise for this program, while home economics research is conducted at Winthrop College.

Facilities at Clemson and at four research and education centers located across the state provide indoor and outdoor laboratories for scientists in agricultural economics; agricultural education; agricultural engineering; aquaculture, fisheries and wildlife; agronomy; animal science; dairy science; entomology; food science; horticulture; plant pathology and poultry science.

Branch research and education centers are Edisto at Blackville, Sandhill at Pontiac, Pee Dee near Florence and Coastal near Charleston. The Simpson Experiment Station near Pendleton also serves as an outdoor laboratory for campus researchers and faculty.

Researchers at these regional centers conduct studies and carry out experiments relating to growers and crops in their respective geographic areas under constraints and conditions of different soils and climates.

During this fiscal year, the Experiment Station strengthened its current research programs and addressed future needs by responding to new concerns in the agricultural industry. Efforts were focused in biotechnology, packaging science, aquaculture and ornamental horticulture. Research programs will continue to expand to meet the demands and needs of the public so they can make wise decisions based on the knowledge provided.

In all 50 states, Experiment Stations conduct both cooperative and complementary research. They avoid duplication of efforts and build on the foundation of information which has been primarily responsible for advances made in agriculture during the past 100 years.
To meet future challenges, the South Carolina Agricultural Experiment Station will continue to produce new research findings to add to those of its counterparts across the country in meeting a common goal — creating better standards of living for people through the wisest and best use of natural resources.

The following summary is a capsule review of the extensive research program at the Experiment Station. Many important studies may have been omitted, and those that follow are intended only to illustrate the scope of the total program.

**Agricultural Economics and Rural Sociology**

The primary missions of Agricultural Economics and Rural Sociology are to conduct research that improves the efficiency of agricultural production in South Carolina; to help make South Carolina agriculture more competitive relative to other geographic areas of the United States and other parts of the world; and to predict the effects of changes in national and international economic conditions and changes in U.S. government programs on agriculture and rural areas in South Carolina and nearby areas. More than 80 percent of South Carolina’s 30,823 square miles are devoted to farming or forestry.

Agriculture in the United States and South Carolina continues to be highly efficient. U.S. consumers now spend less than 13 percent of their disposable income on food. This compares to more than 25 percent in Japan, around 23 percent in West Germany, 40 percent or more in Mexico, 45 percent or more in the Soviet Union and more than 60 percent in China.

Demographic research predicts that by the year 2000, only 72,000 of South Carolina’s estimated total population of 4.1 million people will live on farms. Another 741,000 people, however, will live in rural areas — rural non-farmers. One-half of all S.C. people will live in or near four metro areas: Greenville-Spartanburg-Anderson, Charleston, Columbia and Florence-Myrtle Beach.

Economic development and personal income growth in South Carolina still depends greatly on new industry, as in the past 40 years. But now, more than ever, it depends also on the growing retirement population. South Carolina’s economy is being driven more and more by pension incomes and by income from dividends, interest and rents.

Beef exports, especially to Japan, are giving a huge boost to beef prices and thus to S.C. beef farm income. Japan accounts for 70 percent of U.S. beef exports. South Carolina beef cattle farm income increased by 52 percent from 1986 and 1988; it may increase another 40 percent from 1988 to 1990, to a new total of more than $200 million.

Recent research predicts the best chances for vegetable export are into densely populated, fast-growing Asian economies, particularly Japan and Indonesia. Less potential exists in EC Europe and Eastern Europe. Only small chances exist in Latin American and African nations.

New Geographic Information Systems (GIS) computer research will enable city and county leaders to see vivid color images of their roads, water systems, sewer systems, school transportation routes, etc. on large- or small-screen TV monitors. Proposed infrastructure improvements can be evaluated (mapped out and altered) using GIS research. Regional and state economic development trends can be simulated via GIS.
Agricultural Education

Agricultural Education includes the processes of education applied to the scientific body of agricultural knowledge. Research should build upon the existing professional knowledge base that includes theoretical, developmental and applied inquiry. It includes research in learning, curricula development, delivery methodologies, assessment of relevance and program effectiveness, and the projection of future educational needs of youth and adults.

In a 10-year follow-up of Clemson Agricultural Sciences graduates, oral and written communications, problem solving and critical thinking, and human relations competencies were valued more highly than specific agricultural science competencies. These competencies were evaluated both for entry-level employment as well as career advancement.

Agricultural Engineering

The mission of the Agricultural Engineering Department is to provide the engineering output for the management of biological and agricultural systems and human and natural resources for effective and efficient production, processing, storage, distribution and utilization for the food and non-food needs of society. Five of 40 research projects are highlighted here.

New technologies have been developed to measure the foliage that covers the ground for a growing crop. This is important in the new tillage and harvesting systems that will operate with less driver/operator input. A digital camera was used to collect the data, and a computer was used to analyze the images to show the percentage of soil cover. Image processing will eventually be commonly found on most agricultural equipment in the years ahead.

Automatic controls for tractors have been developed to increase efficiency and conserve energy. A tractor was instrumented to collect information on wheel slippage, fuel consumption, draft horsepower required and forward speed. With an on-board computer analyzing the collected information, tests could be run to maximize the efficiency of the tractor when pulling various tillage implements. Information was correlated to soil conditions and soil type so the results could be applied to farms in most of South Carolina.

Furrow diking is a method of installing small dikes in a row crop to reduce rainfall runoff. Experiments were conducted to determine if furrow diking in irrigated corn would increase the efficiency of irrigation systems. Results have shown that there is more water available in the late growing season when diking is used. A mass balance of water inflows, outflows and the resulting change in storage is being developed to evaluate the impact of high rainfall conditions.

A low-cost, multi-purpose vegetable production machine has been developed and tested. It can support all major functions of controlled traffic production of vegetable crops. These functions include: seedbed preparation, seedling irrigation, spraying, transplant harvesting, cultivation and harvesting. This 3m wide, high-clearance machine is self-propelled and is adaptable to all aspects of mechanized vegetable production. A used tobacco harvester served as the framework for the machine. It has been tested at the Pee Dee Research Center in Florence and on campus.
Experimental work has been completed to develop a system of mechanized micropropagation for small tomato seedlings. This type of system is important for scaling up plant tissue culture operations. To go from a lab scale tissue culture system, where everything is done by hand, to a system where thousands of plant tissues must be handled each day will require an engineering design that is reliable, efficient and can manipulate a biological material that varies in shape. Polypropylene film has been tested as a substitute for the traditional agar growth media. New materials and methods are required to meet the engineering needs for the growing plant biotechnology industry.

**Agronomy and Soils**

Weed control researchers are exploring the application of herbicides to narrow bands in fields of row crops. Combined with cultivation, this practice could reduce the use of chemicals, yet maintain or improve weed control. If successful, the technique will reduce chemical inputs required for cost effective crop production, thus reducing both costs of production and concerns relating to environmental quality.

Characterization of the soybean genome is under way. This application of biotechnology is being used to identify sources of pest resistance for Clemson’s varietal development program.

A study of the amount of nitrate that has accumulated in agricultural fields is under way. The purpose is to document the potential for groundwater contamination caused by fertilization or use of animal wastes in crop production. This documentation will provide a basis for commenting on any future regulations which may be proposed, and to address public concerns about agriculture’s perceived environmental impacts.

Naturally occurring organic acids have been found to stimulate the release of sulfate from South Carolina soils and those typical of the Southeastern United States. This has implications to the effect of acid rain on soils and the plant availability of nutrients in the soil zone proximate to plant root surfaces.

Tests of a number of canola varieties planted at different times from fall through the late winter have been conducted at the Edisto Research and Education Center. The results can be used by producers to answer questions relating to the profitability of growing this new crop.

New sampling procedures for manure and other agricultural wastes have been developed in collaboration with the Soil Test Laboratory. The new procedures will help farmers make more efficient use of the crop nutrients in this valuable waste and also reduce the potential for contaminating water resources.

Clemson’s research on interseeding soybeans into standing wheat has progressed to the stage of on-farm testing under commercial conditions. This work is a joint effort with the Agricultural Engineering Department and is funded by a grant from the USDA’s LISA Competitive Grant Program to Clemson and the University of Georgia.

**Animal Science**

The mission of the Animal Science Department reflects the traditional philosophy of service implicit in the charge to land-grant universities. The department focuses on the
needs of animal agriculture in South Carolina with a clear realization of responsibilities extending to regional, national and international animal agriculture. This mission-oriented approach recognizes: the need to search for answers to questions and problems of the industry; the need to develop new knowledge upon which tomorrow’s competitive advantage through efficiency will be based; and the need to apply and make available today’s technology through producer education and decision-making assistance.

The research mission of the department concentrates on four species — cattle, pigs, horses and sheep — with four primary discipline areas of breeding and genetics, reproductive physiology, nutrition and meat science. Team research, both within and outside the department and college, is utilized.

An evaluation of a synthetic prostaglandin, Luprostiol, for synchronizing estrus in mares indicated no side effects such as profuse sweating and increased respiratory rates as have been observed with other drugs of this type. Eighty-nine percent of the mares were in synchronized heat, and 61 percent were pregnant following treatment.

Cows in early luteal stage of ovarian function (within five days of last heat) do not respond to present synchronization of estrus treatments. With a new drug combination developed by Clemson animal scientists, synchronization response can be increased by more than 20 percent in cows treated within this period of their cycle.

A positive response in cows returning to heat early after calving was observed if cows were exposed to sterile bulls or cows treated with male hormones to behave like bulls. When cows were placed with these teaser animals when they calved, they returned to heat 10 days sooner after calving than cows not exposed to teaser animals.

Research has shown that pork can be selected for leanness at an early age and that higher amounts of protein in the pig diet will increase the total lean in the carcass. Ruminants are “pregastric fermentors,” meaning that feed nutrients must first pass through an extensive gut microbial population before they reach the animal tissues. Some of these nutrients are essential for tissue growth and function, but are low or not available because of microbial degradation.

Nutritional biochemistry and microbial metabolism studies have identified specific compounds that are resistant to degradation by intestinal microbes. Thus, essential nutrients can be supplied to animal tissues in adequate amounts of maximum growth and function. Also, the mechanism of how certain fatty acids inhibit the growth of intestinal microbes is being investigated by electron microscopy and autoradiography.

**Aquaculture, Fisheries and Wildlife**

Scientists are developing and refining techniques for profitably culturing aquatic animals in the coastal and inland waters of South Carolina. Areas being addressed include economics, food science, water quality, mechanization, production systems, genetics, physiology, microbiology and environmental impacts. Examples of current research projects are presented below.

Traditional channel catfish culture techniques yield fish that are variable in size — .75-1.75 pounds. Processing plants prefer 1.25-1.5-pound fish. Researchers are developing techniques to reduce the variability in size at harvest. Significant reduction in harvest variability has been obtained by reducing the size variability of the fingerlings stocked.
Losses due to bacterial diseases are a priority concern of the Catfish Farmers of America. Studies to improve the resistance of channel catfish to bacterial disease by vaccination and diet manipulation are in progress.

Cage culture of channel catfish is an alternative to open pond culture systems. Cage culture allows farmers to reduce capital costs by using existing ponds rather than building specialized production ponds. Researchers are developing cages and cage culture techniques.

Crawfish production is highly seasonal resulting in large volumes of product being available from November to May. During this period, state farmers receive about $1.45 per pound for live crawfish. Research focuses on extending the harvesting season to allow farmers to take advantage of premium off-season prices.

Crawfish production per acre is low (about 500-600 pounds) when compared to channel catfish production (about 4,000 pounds). A major reason for low production is that production ponds are extensively managed (relying heavily on natural reproduction and food production). Studies are directed toward increasing per-acre yield by stocking juvenile crawfish and using prepared feeds.

A major problem in the culture of these fishes is loss due to handling and transporting. Studies are under way to determine optimal temperature and salinity combinations in which to transport these animals.

Nitrogenous wastes, ammonia and nitrite, are a serious limiting factor in high-density aquaculture systems. Studies are under way to characterize the toxicity of these substances to hybrid striped bass and red drum. Based on these studies, acceptable criteria will be developed for use by culturists.

A major question related to shrimp farming in South Carolina concerns the impact of effluents from shrimp culture ponds on estuaries. Research on this problem addresses two points. First, what is the impact of effluents on estuaries, and second, what is the best way to treat effluents in order to reduce impact.

A major constraint in clam culture operations is the availability of seed. Studies are in progress to develop techniques to provide a reliable seed source.

Oxygen is the primary limiting factor in aquaculture production. An understanding of oxygenation and a means to increase rates of oxygenation will allow increased production of several species. Studies are in progress to understand the dynamics of mixing and phytoplankton respiration in ponds.

As the aquaculture industry grows and the volume of product increases, several aspects of production must be mechanized. Projects are under way to improve feeding, aerating and harvesting equipment.

An understanding of the economics of the aquaculture industry is required if sound investment and production decisions are to be made. A regional study is being conducted to analyze the production and marketing of aquaculture products.

**Dairy Science**

Nutrition, reproductive physiology and health of dairy animals are research thrusts in dairy production, while increasing shelf life of milk and dairy products remains the chief area of research interest in dairy manufacturing.
A trial using recombinant bovine somatotropin (BST) administered to high-producing Jersey cows daily or at 28-day intervals has produced an increase in milk production, an improvement in feed efficiency and caused no effect in animal health or reproductive efficiency when compared to cows receiving no BST. This study is continuing, and data will be analyzed at the trial’s termination. The use of BST could increase the state’s local milk supply without apparent harm to the animals, and FDA has ruled that milk from BST-treated animals is safe for human consumption.

Porcine embryos have been cultured in the absence of bovine serum albumen (BSA) with solcoseryl (SOL) being substituted in a conventional ovine embryo culture medium. A SOL-BSA-supplemented medium also was used. This study indicates that porcine premorular embryos can be cultured to the blastular stage in a BSA-free medium that contains SOL, but that greater development occurs with a combination of SOL and BSA supplementation. The study of early embryonic development and even storage of embryos will be greatly facilitated with an improved embryo culture medium.

Effects of aflatoxin B1 on bovine and avian T-cell function in vitro are continuing to be studied. Uptake of 3H-aflatoxin by bovine T-cells approached 15 percent with the radiolabel being distributed principally in the cytoplasm (60 percent) with less than 15 percent in either the nucleus or mitochondria. Also AFB1 has been shown not to greatly reduce microphage II-1 in calf thymocytes. Turkey peripheral blood lymphocytes have been shown to be highly sensitive to aflatoxin B1.

Research has been initiated to determine the effect of chilled drinking water on production responses in lactating Holstein cows. Preliminary observations indicate that water consumption is not affected whether chilled to 50 F or at ambient temperatures varying from 68 F to 76 F. Milk production, feed consumption, respiration rates and effect on milk consumption are to be observed. Unpublished data from Clemson research has shown a drop in dry matter intake and milk production during the hot summer months of 1987 and 1988. These drops were directly related to increased temperature and humidity conditions. This study will determine the effectiveness of providing chilled water on feed intake and milk production.

Research is under way to develop a rapid milk shelf life prediction bioassay, using cross-reacting antibodies to spoilage bacteria. The assay has been perfected, and an antigen-adjuvant mixture is being administered to rabbits to produce the antibodies. With such a bioassay, processors would have a much improved control of quality of milk and dairy products from the standpoint of lowered shelf life resulting from spoilage microorganisms.

**Entomology**

Entomological research is focused on pushing back the frontiers of knowledge; to render service in the form of research information to the citizens of the state, nation and world; and to develop collectively and individually as professional entomologists.

The principal research thrust is in the areas of low-energy, comprehensive integrated pest management (IPM) technology. The main objective is to maintain pest populations below economically damaging levels while reducing the use of expensive and ecologically disruptive pesticides. Basic and applied research programs are listed below.
Peach trees are attacked by two borers, *Synanthedon pictipes*, the lesser peach tree borer and *Synanthedon exitiosa*, the peach tree borer. The larvae of both species feed on the cambium layer and are capable of causing significant injury to the trees. Peach tree borers are controlled with an annual insecticide trunk spray. Lesser peach tree borers are active during the fruiting season and generally are not controlled. Research has shown that the females of both species release a powerful sex pheromone (attractant) that draws males from considerable distances. Research is under way to study the feasibility of disrupting mating by releasing large amounts of the sex pheromone during the mating season and preventing males from finding the females. This research may lead to the development of an environmentally sound alternative to traditional insecticide control of these borers.

A survey of black flies of South Carolina shows that 38 species exist in the state. Most of these species have been examined cytogenetically and their chromosomes compared with those of species from other parts of the country. These studies have revealed one new species of black fly that is a potential vector of *Leucocytozoon*, an organism causing a malaria-like disease in birds such as turkeys.

Data from the past two seasons have indicated that early season infestations of the tobacco budworm, *Heliothis virescens*, on cotton do not need to be treated with insecticides. If confirmed by extensive tests in four locations, these results could save state cotton growers well over $100,000 in early-season insecticide costs.

Research during the past two seasons with genetically manipulated strains of the biological insecticide, *Bacillus thuringiensis*, has identified a strain that provides excellent control of soybean looper, a pest that is highly resistant to pyrethroids and most other insecticides. This strain of Bacillus is now commercially available on “Condor” to state soybean growers. This product provides excellent control of loopers on soybean with one application, whereas high populations often require repeated applications of any other material.

**Food Science**

Biotechnological techniques continue to be used to investigate methods to provide a safe and high quality food supply. Model systems are being used to identify methods to produce compounds that will prevent the growth of pathogenic or spoilage microorganisms. It is known that some bacteria can protect themselves against other organisms. Also, such protection results from the production of compounds such as proteins. A search is under way to identify microorganisms that can produce such compounds. Thus far, at least three organisms have been identified. Those organisms are being utilized to allow scientists to increase production of the protective compound so that its ability to protect against pathogenic or spoilage microorganisms can be tested.

Additional research is being applied to identify the genetic codes and to determine methods to efficiently produce them for use in foods. Model food systems are being designed to test the effects of such compounds and their effect on other organisms and new detection systems.

A new initiative for food processing and packaging research began this year with special funds from the state Legislature. Food scientists have utilized knowledge gained
through Experiment Station projects, in conjunction with agricultural engineers, horticulturists and animal scientists to begin research in the areas of food processing and packaging.

The environmental impact of packaging is a critical issue. Research is being conducted to develop alternate, edible packaging materials from agricultural products such as soybean, wheat and corn. Other food scientists are utilizing various packaging films to provide food and other S.C. agricultural products with high quality and longer shelf life so that they may be more competitive within the Eastern region and international markets. Examples of these products are ground meat, eggs and egg products, and selected fresh vegetables including cabbage, lima beans and broccoli.

Red and white meat products are being investigated for new product applications. Examples include poultry breast meat processing using unique cook-in films. Determinations of optimal package film-to-meat adhesion allows for retention of yield in poultry meat products. Other interactions of meat-to-film studies show that relationships may be predicted in a color change of the finished product. It was shown that selection of the correct film can extend the shelf life of shrink-wrapped Red Globe peaches by one-third under the appropriate conditions, and can also decrease weight loss with better color retention.

Metallic membrane ultrafiltration research continues to provide important results in determining the ability to separate food components for various purposes. Using the membranes to determine the availability of calcium has been shown feasible. These results can lead to the better understanding of how processing effects food.

Rapid detection of nutrient availability can be used to show the best way to process foods to assure nutrient content in critical dietary situations. In related research, a joint patent has been issued to Clemson University and Ross Laboratories, a division of Abbott Laboratories, entitled “Enrichment and Concentration of Proteins by Ultrafiltration.” This patent describes an important method by which biochemically significant components of milk can be separated and used in special food and medical applications.

**Horticulture**

The amount of nitrogen fertilizer used in the production of green bunching onions can be reduced by 66 percent by the use of controlled-release fertilizers. This reduces the total nitrogen applied to soils and reduces the potential for groundwater contamination by leaching.

A comprehensive study was conducted in cooperation with the Agromedicine Program to determine the rate and extent of pesticide accumulation in tomato packinghouse wastewater. These data will be used for future management decisions on wastewater disposal so that environmentally appropriate measures can be taken.

Further refinement of the system used to alter light quality surrounding vegetable crops in field plantings has led to the development of a bilayer plastic mulch which changes color during the progression of the growing season. This system allows for rapid establishment and early growth while still providing optimal reflected light for modification of growth habit and yield.

The systems approach to vegetable crops production was presented at the Tri-State Vegetable Conference held in Greenville in February. The conference was a collabo-
rative effort between researchers and extension specialists from the horticulture and agricultural economics departments at N.C. State University, the University of Georgia, Clemson, the agriculture departments in Georgia and the Carolinas, and regional produce buyers. Optimal production systems for new and existing crops were revealed; a full seasonal availability model was described. Efforts to refine production systems for existing crops and to introduce alternative crops such as spices, asparagus and cut flowers is continuing.

Several personnel have introduced an international dimension to their research efforts. Watermelon germplasm has been obtained from cooperators in China, and vegetable production regions in China, Egypt, Italy and Chile have been studied.

A faculty committee has designed the new buildings to be built at the Musser Farm. Limited construction is under way.

Several phases of the peach research program were presented at the Sandhill Field Day. Several rootstocks have promise in peach production systems. One rootstock delays bloom by 10 to 14 days, which may enable avoidance of fruit loss due to late spring frosts.

Several selections have survived on a peach tree shortlife "hot site." These currently are being propagated and will be evaluated for compatibility with named varieties in field tests.

A new variety is being prepared for release from the peach breeding program. Carogem will be available through the virus-free program in the near future.

Modification of the light environment in greenhouses by using colored filters can be used to alter plant growth. Chrysanthemums, poinsettias, bedding plants and other crops can be grown without using growth regulators to reduce plant height. Crops are shorter, darker green and of higher quality without added chemicals.

New varieties adapted to state growing conditions are being evaluated at several sites. Test sites include the crabapple evaluation at the Sandhill center, as well as demonstration plots at the Coastal center and at the Clemson University Botanical Garden. Several traditionally field-grown ornamentals are being evaluated for their potential as florists’ pot crops.

Production systems being studied include efficacy studies of herbicides and fertilizer and irrigation studies.

Computer information systems that link information databases with laser videodisks of stored plant images have been developed. The computer system, MacRAPID, developed by Experiment Station scientists, allows the user to see a TV image of plants that meet user-specified criteria. Garden centers, classrooms and Extension offices will use this technology in helping the public select plants ideally suited to their needs.

A new chimeral Rhododendron cultivar, to be named Carolina Jewel, was developed through plant tissue culture. Carolina Jewel appeared as a variant in a study that was being developed to enable true-to-type micropropagation of chimeral rhododendrons.

Almost one acre of tissue-cultured tomato plants that were exposed in vitro to thermal neutron radiation are planted at the Coastal center. This industry-sponsored project is designed to select tomato plants with improved processing characteristics.

Techniques to clonally propagate watermelons and muskmelons are being developed. These techniques will enhance production of weak-seeded types, especially
triploid seedless watermelon. Watermelon tissue culture also is being used to obtain somaclonal variants as an adjunct to the traditional breeding program.

Researchers are cooperating with scientists in the College of Sciences on a project designed to use recombinant DNA technology to identify cultivars of hybrid tea roses. This technology will ensure accurate plant “fingerprinting” and will be widely used in the process of protecting plant patents.

**Plant Pathology and Physiology**

The Plant Pathology and Physiology Department is responsible for developing and recommending controls for plant diseases and other plant disorders in South Carolina. To ensure that growers and homeowners get the information needed, the faculty and staff do some of the basic research, test controls sold by commercial companies, and cooperate with other scientists to develop resistant varieties.

Major causal agents of plant diseases include bacteria, fungi, viruses and nematodes. Part of the work of a plant pathologist is to separate the bad organisms from the good ones and being able to suggest a reasonable control. Pesticide effectiveness, action and fate in the environment also are projects on which researchers work.

Research highlights for the past year include the completion of a five-year rotation series designed to manage root-knot nematode populations. Substantial reductions in nematode damage can be obtained with rotation crops such as corn, cotton, sorghum and small grains. It is important to know the root-knot nematode species. Crop sequence and nematicide application was shown to alter the ratio of root-knot nematode species. For instance, the use of soybean increased the levels of the peanut root-knot nematode in relation to the more common southern root-knot nematode. Use of the soil fumigant 1,3-D also results in populations with a high percentage of the peanut root-knot nematode, which is harder to control and for which there is less host resistance.

Host plant resistance is the way several plant diseases are controlled. About 3,000 breeding lines of soybeans were tested for soybean cyst nematode resistance again this past year. This program has resulted in several soybean lines that have promise for use in production in South Carolina. Concurrently, progress was made toward defining tolerance characteristics in soybean lines for the Columbia Lance nematode. Tests were run for establishing a faster system of testing for septoria resistance in wheat. And, most tobacco varieties being proposed for release are being checked for resistance to several disease-causing organisms. Screening continued for either resistance or tolerance to ring nematodes in peach rootstock materials.

Several peach tree short life soil sites suppressive for multiplication of ring nematodes on peach trees have been identified. Bacterial isolates from roots growing in those soils have been collected and are being screened for nematicidal activity. One isolate has been effective for reducing nematode activity.

**Poultry Science**

While testing, feeding and weighing have been important research undertakings for a poultry science department, the primary research role of the modern department should be research that asks questions that will advance the basic understanding of
poultry. Since the poultry faculty has expertise in immuno-physiology, genetics, nutrition, pathology and reproductive endocrinology, the department's fundamental research has been in these areas. The conceptual approach requires extensive laboratory investigations (e.g., molecular emphasis) and thus may be considered "long-term research." The department believes that the poultry industry should derive the most benefit from such research. Within the framework of modern laboratory experimentation, researchers in the above disciplines utilize similar techniques which will foster increased cooperation.

To stimulate cooperative research, the department initiated an umbrella program in 1987, Immunoenhancement of the Embryo (IMENE B), which was enlarged to include the Animal Science and Dairy Science departments (Functional Enhancement of the Immune System During Embryonic Development, FEISDED). The concept of IMENE B was, in part, responsible for the initiation of numerous new research efforts.

The avian thrombocyte, similar to the human platelet, is known to play a role in hemostasis and phagocytosis. Yet, no one has been successful in purifying the cell. The department purified the thrombocyte and then initiated studies to learn more about its function. During heat stress, the thrombocyte experienced changes in lactic acid production, RNA and protein synthesis, and AP4A release. The thrombocyte's cyclic response to AP4A may be related to a stress response.

Two researchers working with a dairy scientist have identified a unique defense system employed by vertebrate macrophages as revealed by DNA analysis. This research offers: 1) basic information concerning the reduced viability of turkey sperm; 2) methods of maintaining the fertilizing capacity of newly obtained sperm; and 3) valuable data that may improve the capability to protect against pathogens.

In a cooperative effort with the College of Sciences, researchers have utilized genetics probes to identify methods of improving feed utilization and disease resistance in poultry. This research is ready for in vivo testing. Immunological pathogens have been utilized to study the influence of lipids on metabolism.

Another project has incorporated cloning and recombinant DNA to identify the optimum portion of a pathogen necessary to elicit immunity. The department has cooperated with a Finnish company in the establishment of a facility and research effort to take place at Clemson to determine the efficacy and mechanism of a potential fermentation product in the elimination of salmonella.

The environmental impact of aflatoxin on the immune system has been investigated. In addition, Flow Cytometry (the Cell Sorter) has been used to study cell kinetics in a major lymphoid structure, the Harderian Gland.

A monoclonal antibody (mAb) has been shown to identify a precursor cell that appears to play a central role in the micro environment of the B-cell. The cell and/or its product(s) may be important in improving the animal's ability to adapt to its environment.

Coastal Research and Education Center

The primary responsibility of the Coastal Research and Education Center is to develop efficient and economical systems for commercial vegetable production in South Carolina. A primary goal is to become a center of excellence for vegetable research.
Research on pesticide contamination of packingline wastewater involves all South Carolina tomato packers. Results indicated that growers who participate in integrated pest management (IPM) programs cause less water contamination than non-IPM growers. Research is being performed in cooperation with the Agromedicine Program of the Medical University of South Carolina to quantify toxic contamination of packingline wastewater.

Experiments have been initiated to determine the best variety and shipping conditions for the export of watermelons from South Carolina to England. Thirty-seven varieties are being evaluated for storage potential and sensitivity to chilling injury. Additional work focuses on the effects of individual shrink wrap packaging on shipping quality.

Today’s emphasis on novelty in the marketplace is leading the development of new tomato varieties in “designer” colors. The first tangerine-colored tomatoes will be tested on state farms during spring 1991. They are firm and meaty, but retain good flavor. Crimson, orange, yellow, pink and apricot varieties are still in the developmental stage.

The indigenous parasite *Diadigma insulare* controlled the diamondback moth on collards when applications of broad-spectrum insecticides were avoided. To date, five parasite species have been identified from this important caterpillar pest, which is showing resistance to insecticides in South Carolina.

Commercially available *Bacillus thuringiensis* (B.t.) and experimental, bioengineered B.t. effectively controlled all caterpillar pests of crucifers, while a broad-spectrum pyrethroid insecticide caused populations of diamond-back moth and cabbage loopers to increase. This was attributable to destruction of indigenous beneficial arthropods.

Experiments are under way to assess the impact of predators, parasites and entomopathogens on major insect pests of vegetables, and procedures are being developed for conservation of these important biological control agents.

Asparagus and broccoli are being evaluated as alternative crops to traditional vegetables in the coastal region. Asparagus was forced into production during “off season.” This year’s data showed good potential for the possible use of these techniques commercially.

Methods are being developed to reliably predict the planting and expected harvest of broccoli. Research shows that broccoli production can continue successfully into late spring and summer at times previously considered impossible.

Most tomato fields in the coastal region are transplanted before the last killing frosts in spring. However, early transplanting may detrimentally affect earliness, yield and quality of the crop. Tomato transplants, exposed experimentally to alternating temperatures before planting, were unaffected by cold temperature stresses.

**Edisto Research and Education Center**

The Edisto Research and Education Center’s mission is to carry out research, extension and teaching programs that focus on agricultural problems unique to the Coastal Plains. Emphasis is placed on problems that demand multi-disciplinary team approaches for solutions. The goal of the center is to develop, evaluate and transfer new and improved technology for agricultural production and to provide current information required to use traditional technology.
Interseeding of soybeans and cotton into standing wheat with controlled traffic has shown that this system is an effective conservation measure which reduces erosion and energy use but does not reduce yields of wheat or soybeans. Significant progress was made in getting an instrumented John Deere 4050 4-wheel drive tractor functioning in the field to obtain energy data. Compared to a conventional 2-wheel drive tractor equipped with dual rear tires, preliminary data indicated an increase of 25 percent more traction with the 4-wheel drive in Coastal Plains soils. The instrumented tractor was helpful in determining energy requirements of new tillage tools for the Coastal Plains. The energy and draft force requirements for a revolutionary concept called the “Switch Plow” were determined.

Research using resistant varieties, biological pesticides and crop rotations continues to show that combinations of these methods are effective in reducing pest damage in a number of crops such as small grain, cotton and soybeans. Because of the complexity of controlling pests and their ability to adapt to control strategies, the results of these studies emphasize the need for on-going research to maintain an effective level of control.

Studies with two alternative crops, canola and flax, show that these crops have potential for the Coastal Plains farmers. There were great differences in the performance of various canola varieties. Some types are not adapted to the Southeast. Nitrogen rate studies showed that canola will require slightly more nitrogen than wheat. Date of planting tests were conducted to determine optimum planting dates for flax and canola.

Experimental results showed a potential for grazing wheat and then harvesting grain. However, grazing management was critical in order not to reduce grain yield. This system can increase Hessian fly populations; therefore, varieties that are resistant to the Hessian fly had an advantage over the non-resistant varieties.

Increases in total rye forage production have been shown by manipulating grazing management. These increases in forage production suggest that cattle production can be enhanced without additional capital resources.

New research in control of insects and nitrogen requirement for cabbage was initiated in response to needs of Blackville farmers who began growing cabbage on a commercial basis.

During the year, three graduate courses were taught at the center. An open house program for school children was attended by more than 1,100 students. Planning for a new multi-purpose headquarters building was started.

**Pee Dee Research and Education Center**

Scientists working in tobacco have developed several breeding lines that have resistance to the tobacco budworm and the “peanut” root-knot nematode and have good potential for varietal release in the near future. They also tested a genetically altered bacteria that was found to be effective in controlling the tobacco budworm.

Engineers developed mathematical models in describing air-flow and loading density that could improve the quality of tobacco cured in bulk barns. They also developed the concept for a “farmer-friendly” computerized tobacco curing system.

An economical sound trap was developed and tested in cooperation with the University of Florida to monitor adult mole cricket populations, a problem in tobacco and golf courses.
Eleven new cotton germplasm lines were released in conjunction with USDA scientists that have good varietal potential for short and long season as well as mid-range harvest.

Scientists also found that mulch color can greatly impact the yield losses to root-knot nematodes. Tomatoes grown over red or white plastic mulch and infested with the nematode yielded 111 percent and 102 percent, respectively, greater yield than similar plants grown over black plastic.

Two deep irrigation wells were completed, and underground lines were installed that will give irrigation potential for research plots in years of drought.

**Sandhill Research and Education Center**

The mission of the Sandhill Research and Education Center is to conduct research and extension programs in fruits, vegetables, ornamental crops and swine.

The peach certification project produced 180,000 finished virus-free trees this year. Forty thousand of these trees were planted in South Carolina. The project continued to supply seed of the peach rootstock Nemaguard to Egypt. Approximately 10,000 pounds of seed have been shipped to Egypt in the last four years.

Research on a possible role of prunus necrotic ringspot virus in the peach tree short life (PTSL) syndrome indicates that the virus does not appear to be involved. Mortality at the end of four years was no greater in virus-infected trees than in healthy trees.

Studies are being conducted at the Sandhill Center and on a grower’s farm in Lexington County to determine the critical leaf tissue nitrogen content of green bunching onions to ensure that the plant has adequate nitrogen in the tissue for optimal growth. Studies indicate that the nitrogen rate can be reduced by 50 percent by using controlled release nitrogen rather than soluble sources of nitrogen such as ammonium nitrate and calcium nitrate.

Studies were conducted to determine the basis for cultivar susceptibility to tipburn of collards, a serious problem that results in leaf cupping and marginal burn of young leaves when this crop is grown under high temperatures. Vates, the standard open-pollinated cultivar is susceptible to tipburn, while the hybrid cultivars Blue Max and Heavy Crop are tolerant of this disorder. Tipburn of collards is caused by a localized calcium deficiency in the tip of young leaves. The rate of calcium uptake is greater for Blue Max than Vates, which may contribute to Vates being more susceptible to tipburn.

Woody ornamental research efforts with fertigation on Nelle Stevens holly found no difference between fertilizer treatments in plant index, trunk caliper or plant width, but a significant difference in plant height.

Planting of 50 crabapple cultivars in the National Crabapple Evaluation Program was completed. The National Crabapple Introduction Program was initiated with four new cultivars.

The use of hydrophilic gels to amend pine bark potting media improved the waterholding capacity but did not increase the amount of water available for immediate plant use.

The Swine Evaluation Center, located at the Sandhill Center, genetically evaluated 165 boars in 1989. All boars compiled an average daily gain greater than any year since the program began in 1974. Improvement in all production traits was observed in this 16th year of swine evaluation.
Active Research Projects 1989-90

Agricultural Economics and Rural Sociology

Socioeconomic dimensions of technological changes, natural resource use and agriculture structure.
Marketing strategies for agronomic crops with uncertain prices and yields.
Analysis of structural and organizational changes in rural counties in the South.
Changing patterns of food demand and consumption behavior.
Potential for community economic development and its impact on rural residents.
Economic and technical forces shaping the Southern dairy industry.
Competition and change in the fruit and vegetable production and marketing system.
Agricultural adjustment in the Southeast through alternative cropping systems.
Econometric analysis of yields of major agronomic crops in South Carolina.
Changing structure of local labor markets in non-metropolitan areas.
Quantifying long-run age risks and evaluating farmer responses to risk.
International trade research on commodities important to the Southern region.
Economics of wetland preservation.
Economics of disadvantaged regions.

Agricultural Education

Labor force experiences of persons trained in colleges of agriculture.

Agricultural Engineering

Automatic monitoring and controlling grain storage.
Engineering systems for plant tissue culture.
Automatic control of field machine functions for increased efficiency and energy conservation.
Compost for control of apple collar rot.
Hydrologic/water quality modeling of sediment and chemical movement.
Low-cost, multi-purpose vegetable production machine/system.
Control prediction, economics and environmental effects of soil erosion.
Agricultural application of machine vision system.
Dynamic modeling of water quality in aquaculture.
Edible films from cereal grains and soybeans.
Predicting groundwater recharge in the Piedmont.
Integrated systems and controls for processing and storing agricultural commodities.
Systems for providing and controlling interior environments for poultry and livestock.

Development and verification of a thermal process model for continuous-flow food mix cooking.

Barrier and mechanical properties of edible, degradable films produced from soy and cereal protein.

Packaging of floral products in modified atmospheres for retail sales.

Packaging of fresh vegetables for maximum quality and extended shelf life.

Meteorological research and agricultural management modeling for Southern agriculture.

**Agronomy and Soils**

Grain yields and field performance of barley, oats, rye and wheat.

Advanced strains and cultivars of cotton, soybeans and peanuts.

Field corn and grain sorghum cultivars for grain production.

Development of improved soybean varieties.

Chemistry of atmospheric deposition: effects on agriculture, forestry, surface waters and materials.

Breeding cool-season forage grasses.

Establishment and management of forage crops under stresses of environment and biotic origin.

Characterizing plant traits for improved crop performance.

Mineralogy of selected soils in the Southern region.

Weed control and herbicide-resistant weeds in corn, cotton and soybean.

Effect of soil test values and fertilizer amendments on the nutrient content and yield.

Enhancing beneficial microorganisms in the rhizosphere.

Variability of soil properties and its effect on water quality and soil management.

Cellular and molecular genetics for improvement of maize and fescue.

Chemical parameters affecting aluminum biogeochemistry in Southeastern U.S. soils.

**Animal Science**

Nutrition and management of swine for increased reproductive efficiency.

Effect of gender and feed intake on growth and serum hormones and metabolites of the bovine.

Improving reproductive efficiency of cattle and swine.

Endocrine mechanisms during pregnancy in the cow.

Physiology of pregnancy and embryo survival.
Forage components that influence nutrient digestion and metabolism in ruminants.
Genetic potential of beef cattle for forage utilization.
Genotypic evaluation of Zebu and British-Continental cattle.
Development of profitable beef-forage production systems for the Southern region.
Genetics of body composition in beef cattle.
Selection for improved growth of muscle in swine and the effects on hot processed meat products.
Growth of muscle and deposition of fat in beef as related to genetics and forages.
Influence of seminal estrogens on uterins and ovarian functions in the mare.

Aquaculture, Fisheries and Wildlife

Biology of clams, whelks and other important shellfish.
Lake Moultrie creel survey.
Canada goose nesting biology and gosling survival on farm ponds.
Delta waterfowl and wetland research station — Atlantic Flyway Station.
Environmental requirements and transport-related stress in hybrid striped bass and red drum.
Status of the green salamander in South Carolina.

Biological Sciences

RFLP and molecular analysis of root-knot nematodes, nematode-infected plants and peaches.

Dairy Science

Optimizing nutritional management of dairy cows.
Effects of aflatoxin B-1 on bovine and avian T-cell function in vitro.
Bovine somatotropin (BST) in lactating dairy cows and concentration in dairy foods.
Use of carbon dioxide in frozen dairy-based desserts.
Effects of defined serum replacements and growth factors on cultured ovine and bovine embryos.
Rapid determination of milk shelf-life using antibodies to spoilage bacteria.
Effect of dietary toxins on cellular immunity in cattle, chickens and horses.

Entomology

Entomopathogens for use in pest management systems.
Identification and distribution of insects of potential importance in South Carolina.
Management strategies for insect pests of alfalfa.
Development biology of polyembryonic parasitoids.
Management and biology of arthropod pests of livestock.
Biology, ecology and control of selected cockroach and termite pest species.
Integrated management of cockroaches in structural and industrial environments.
Control of selected insects and mites attacking ornamental trees and shrubs.
Improved systems of control for pecan arthropod pests.
Behavioral relationships of selected pest and nonpest Lepidoptera.
Biology and management of filth flies and other arthropod pests.
Black fly damage thresholds, biology and control.
Behavioral and control studies of red imported fire ant.
South Carolina participation in NAPIAP.
Cloning and analysis of genes for insecticide resistance.
Identification of immature insects by mitochondrial DNA restriction profile.
Bionomics and interactions of corn earworm parasitoids with area-wide management control.
Biology and management of peach arthropods.

**Food Science**

Functional properties of food proteins.
Development of new processes and technologies for the processing of poultry products.
Immobilization of cells and enzymes on metallic membranes for production of food components.
Mineral binding to components of dietary fiber.
Packaging of food products for maximum quality and extended shelflife.
Combined technologies for enhancement of quality in intact and formed meat products.
Egg product development: sliceable, encased ready-to-reheat whole egg products.
Effect of diet on bone noncollagenous proteins.

**Home Economics Extension**

Moisture damage in South Carolina housing.

**Home Economics Research (cooperative with Winthrop College)**

Textile fiber systems for performance, protection and comfort.
Nutritional status and body composition of healthy, black, normal-weight, middle-age females.
Horticulture

Plant germplasm — its introduction, maintenance and evaluation.
Nitrogen and water application practices for ornamentals and turfgrasses.
Quality maintenance and improvement of fresh market peaches and apples.
Breeding of watermelon and evaluation of muskmelon varieties.
Improving plastic mulch and row cover crop systems for vegetable production.
Weed management in cucurbit crops.
Temperature effects on growth and flowering of kiwifruit.
Extending shelf life of floricultural crops by manipulation of postharvest environment.
Propagation, hybridization and selection schemes for the improvement of sweet potato and cucurbits.
Rapid herbicide screening techniques for ornamental crops.
Improved production of greenhouse crops using optical filter technology.
RFLP analysis and DNA fingerprinting in rose cultivars.
New flowering pot plants through chemical growth regulation and/or environmental manipulation.

Plant Pathology and Physiology

Biochemical and residual properties of pesticides.
Biological and chemical control for nematodes and diseases of peach and apple trees.
Causes and control of diseases of woody ornamental plants with emphasis on camellias.
Herbicide resistance and metabolism in tissue culture.
Causes and control of diseases of cereal grains with emphasis on powdery mildew of wheat.
Physiological indicators of stress in peach trees affected by peach tree short life.
Biology of genetically changing root-knot and cyst nematodes of soybeans.
Distribution, ecology and pathogenicity of root-knot nematode.
Characterization of brown patch on centipede and St. Augustine grass in South Carolina.
Control of peach tree short life in South Carolina.
Physiology and molecular genetics of selected plant-bacterial interactions.
Forage legume viruses: identification and genetic resistance for improved productivity.
Poultry Science

Nutritional and hormonal factors influencing structure and quality of eggshells.
Control of food and water intake in poultry.
Factors affecting the ability of the hen to sequester sperm.
Reproductive efficiency of turkeys.
Amylases in chickens: molecular basis and effects on growth rate.
Function of a secretory cell, a Dendritic cell, of the bursa of Fabricius.
Genetic relationships to growth and reproduction in diverse poultry populations.
Effects of cooling avian embryos: immunocompetence and stress.
Functional enhancement of immune system during embryonic development.
Role of AP4A in stress responses of animals.
Production and evaluation of anti-pasteurella antibody from egg yolks.
Immunoglobulin A as an indicator of protection in fowl cholera vaccinated turkeys.

Coastal Research and Education Center

Urban horticulture for coastal South Carolina.
Breeding fresh market tomatoes for bareground unstaked production.
Production potential of summer- and fall-harvested asparagus in coastal South Carolina.
Management of insect pests of vegetables.
Storage potential of South Carolina melons using modified atmosphere packaging.
Improving the export potential of South Carolina watermelons using modified atmosphere packaging.
Improvement of stand establishment and yield of alternative vegetable crops for South Carolina.

Edisto Research and Education Center

Genetic mechanisms for soybean germplasm development.
Breeding and evaluating sweet potatoes for food and industrial uses.
Engineering improvement and management of forage harvesting and conditioning systems.
Physical and chemical characteristics of forages and their relationships to forage quality.
Arthropod-induced stress on soybean: evaluation and management.
Management of Hoplolaimus columbus nematode on cotton and soybean.
Endemic and imported natural enemies of soybean and cotton insect pests.
Insect management in reduced-cost cotton production systems.
A new reduced tillage, wheat-soybean intercropping system for South Carolina. Biological control of selected arthropod pests and weeds through introduction of natural enemies.

**Pee Dee Research and Education Center**

Economic management of tobacco insect pests.  
Impact of integrated crop management practices on European corn borer and related stalk boring insects.  
Bionomics and control of insects on cotton.  
Effect of European corn borer population density on injury to corn.  
Tobacco curing models for maximizing efficiency in bulk box barns.  
Cotton breeding for improved quality, insect resistance and production efficiency.  
Breeding disease and *Meloidogyne arenaria* resistant flue-cured tobacco.  
Cultural practices and variety testing for flue-cured tobacco.  
Tobacco disease and nematode control.  
Influence of mulches on nematodes and diseases in tomato and corn.

**Sandhill Research and Education Center**

Environmental and biological stresses of rootstocks in peach tree longevity.  
Trickle irrigation in humid regions.  
Cultural and management practices of pecans.  
Rootstock and interstock effects on peach physiology.  
Production systems for cool season vegetable crops.  
Viruses and viral diseases of peach.  
Technical and economical efficiencies of producing and marketing landscape plants.  
Virus and virus-like diseases of woody, deciduous fruit crops.  
Hydrophilic polymers for enhancement of agrichemical delivery systems in ornamental crop production.

**Technical Contributions**

2986  HOME RANGE AND HABITAT USE OF EASTERN BLUEBIRDS IN SOUTH CAROLINA by David Allen and John Sweeney [Aquaculture, Fisheries and Wildlife, 7-1-89].

2987  HISTOPATHOLOGY OF A MIXED INFECTION OF IRIDESCENT AND NUCLEAR POLYHEDROSIS VIRUSES IN LARVAE OF ANTICARSIA GEMMATALIS (LEPIDOPTERA: NOCTUIDAE) by Peggy J. Seiburth and Gerald R. Carner [Entomology, 7-6-89].
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2990 ACUTE TOXICITY OF NITRITE TO RED DRUM (SCIAENOPS OCELLATUS): EFFECT OF SALINITY by David J. Wise and J.R. Tomasso [Aquaculture, Fisheries and Wildlife, 7-1-89].

2991 PROTOPTILA MORETTII (TRICHOPTERA: GLOSSOSOMATIDAE), A NEW CADDISFLY SPECIES FROM THE SOUTHEASTERN UNITED STATES by John C. Morse [Entomology, 7-19-89].

2992 BELL PEPPER PLANT DEVELOPMENT OVER COLORED MULCHES by Dennis R. Decoteau [Horticulture, 7-23-89].

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COOPERATIVE EXTENSION SERVICE

For 76 years the Cooperative Extension Service, the educational outreach arm of the Clemson University Division of Agriculture and Natural Resources, has provided information and statewide continuing education programs that have made life easier and more enjoyable for every South Carolinian. The programs cover 16 disciplines relating to agriculture and natural resources, home economics, 4-H and youth development, and community development. In addition to general education information, special programs are included for limited-resource farmers and the economically disadvantaged.

Funded by federal, state and county governments, the Extension Service was created in 1914 as a nationwide system designed to carry education from land-grant universities to the people. Extension has worked closely with South Carolinians helping them build better lives by disseminating practical, useful information within its assigned areas of responsibility.

Originally conceived to help rural people, Extension responded to the changing needs of those it served by broadening its scope of activities to include urban and suburban problems.

Clemson University, through its Extension Service, maintains an office staffed by agents in each county. A professional staff of Extension subject-matter specialists at the University and four research and education centers around the state compiles information from research and translates it into information the people of South Carolina can use day-to-day.

From basic nutrition information to irrigation field tours, Extension staff members and volunteers are teachers carrying Clemson University educational programs to all areas of the state.

The Extension program is organized around these broad categories: agriculture and natural resources, 4-H and youth development, home economics (including the Expanded Food and Nutrition Education Program), community development and 1890 programs conducted by South Carolina State College in cooperation with the Clemson University Extension Service.

Recognizing that new educational programs and directions were needed to teach South Carolinians how to adjust to rapid technological, economic and social change, the Clemson Extension Service and the 1890 Extension program at S.C. State College began an intensive statewide survey in 1985 to determine what citizens of the state saw as today’s most pressing problems.

Each Extension unit and county office took part in the survey, gathering information on demographics, economics, politics, technology and natural resources. Problem identification committees were formed in each county, and more than 1,000 South Carolinians listed 1,803 different concerns that needed attention. These concerns were summarized and listed by priority. More than 5,000 people attended a series of advisory meetings around the state to review plans for solving these problems.

As a result of the statewide survey, the Clemson Extension Service and the 1890 program announced a four-year plan to tackle the concerns South Carolinians say are the most urgent. Twenty teams have been formed to design and implement programs to address each of the major areas of concern.
The teams began work in 1987. The plans of work for 1987 through 1991, put together by county and state Extension staffs and supervised by the program teams, are the result of the intensive statewide survey. To date, the teams have organized and designed programs; trained Clemson Extension staff members in the counties; and evaluated the results of local programs.

Highlights of Extension activities within thrust teams and departments follow:

**Advancing Agriculture and Natural Resources**

**Management and Technology**

**Agronomic Cropping Systems**

Improving profit from field crops, minimizing the impact of production practices on the environment, and producing healthy and nutritious food and fiber products are goals of this interdisciplinary team. Teaching programs are designed to reach farmers with the latest information from research that will encourage growth of field crops using methods and techniques that will protect the environment and man.

Field crops account for more than 75 percent of the income from crops in South Carolina. Soybeans, tobacco, cotton, corn, peanuts, wheat, sorghum and forages are the major field crops. Emerging crops include canola, triticale and flax.

Small grain crops are becoming more important to the farm economy yearly. Conservation tillage, interseeding, controlling soil erosion and water quality are areas closely related to production of small grains. Emphasis in educational programs has been on marketing triticale, cultivar selection, fertilization and management of Hessian fly. Hessian fly is a major profit-limiting factor for wheat. Grower losses exceed $4 million in outbreak years. A comprehensive management program emphasizing selection and demonstration of resistant cultivars, environmentally sound insect control and cultural control has been developed. Adoption of this program can increase state yields by four bushels per acre. This translates to $4-5 million more revenue on a very important crop with which South Carolina can be competitive with any state.

Educational programs on forage production and management provide growers with data on grazing management. Efficient use of forage produced for livestock production are major goals of this activity. County and regional meetings, field days and demonstrations are being used to get the message to producers.

Limiting crop production inputs to those essential for a successful crop can save growers money and minimize the impact of agricultural chemicals on the environment. Our programs are geared to this objective. Cotton particularly lends itself to this goal.

Soil tests are used to determine plant nutrient requirements, and nitrogen is supplied to the crop periodically, so the total nitrogen supply is completely exhausted at harvest. Pesticides are applied based on need. Insect scouting is used to determine insect damage levels, and pesticides are only applied when specific thresholds are exceeded. Weed control programs are aimed at controlling at a minimum cost to both grower and environment. Band application and herbicide selection based on the weeds present in the field are emphasized. These same techniques are being used with other row-crops. Benefits to growers accrue from increased yield, lower costs and less chemical load in the environment.
Classes on cotton plant mapping and physiology help growers manage production. Timing critical practices and evaluating progress of the crop are much more accurate when growers use these techniques.

Aquaculture, Fisheries and Wildlife

Information delivery within the Clemson Extension wildlife program has helped landowners choose alternatives of integrating wildlife management into existing forestry and farming operations on private land in South Carolina. The result has increased wildlife habitat and wildlife production on private lands and given landowners the chance to supplement family income by leasing hunting rights to their land.

Youth education in the 4-H wildlife habitat evaluation program has helped young South Carolinians learn how to make wise land management decisions involving wildlife and how to develop an inner land ethic. Reduction in the extent of damage (agricultural and residential) caused by nuisance wildlife has also been a result of the Clemson Extension wildlife program.

Extension aquaculture has been the leader in dramatic expansion of South Carolina catfish production to the point that fish on about 1,200 acres of ponds are worth about $25 million to the state’s economy.

The Hampton Aquaculture Demonstration Center has helped the commercial catfish industry establish about 1,000 acres of stocked ponds. Fingerlings grown at the Hampton Center have been stocked in 75 4-H projects throughout the state as well as home food production demonstrations. A 50,000-pound per day processing plant has been built in the Hampton area to process catfish.

Another center of catfish production is in Orangeburg where Limestone Fish Company processes fish from area ponds. Two new computerized catfish production budget programs, developed by the Clemson Extension Service, have been helping potential catfish farmers customize financial statements to facilitate financing.

Through work with the S.C. Crawfish Growers Association, Clemson Extension agents and farmers, the S.C. crawfish industry increased acreage to 1,100 acres in 1989. Three softshell crawfish operations were developed by private growers with assistance from Extension. Softshell production will increase the value of crawfish products from $1.25 to $8 per pound average.

The first efforts at processing crawfish commercially in South Carolina were initiated in 1989. Minimum orders for 100,000 pounds of prepared product have been pledged for the next five years. Through assistance from the Clemson University-SCW&MRD Cooperative, shrimp aquaculture production exceeded 500,000 pounds and $1,000,000 in value, ranking South Carolina third nationally in the production of marine shrimp.

The S.C. Shrimp Farmers Association was formed to further the shrimp production through education, marketing and seed sources. The cooperative assisted a local feed mill in producing a shrimp feed, which if used by all farmers in state, would save $100,000 and would give the local mill an extra $250,000, which would remain in South Carolina.
Dairy Management

The South Carolina dairy industry contributes significantly to the state’s economy, generating nearly $150 million annually from the retail sales of fluid milk. The economic impact of dairying is important in 25 South Carolina counties, generating more than $1 million annually in 15 of those counties from the farm sale of milk. Dairies in two counties, Orangeburg and Newberry, sell more than $10 million worth of milk annually. Gross farm cash receipts from milk were more than $68 million in 1989.

Through Clemson University Extension programs, the state’s dairy producers continued to use proven methods to improve their efficiency. Seventy percent of South Carolina dairy producers are enrolled in the Dairy Herd Improvement record program; 60 percent use artificial insemination on at least 30 percent of their matings; 55 percent have forage they feed their animals tested for quality; and 46 percent have rations for their cows formulated with computers.

This year the Clemson Extension Service initiated a collective feed buying program to help participating dairy farmers buy grain more competitively. Twenty producers, with 3,500 cows consuming more than 12,000 tons of grain annually, are taking part. This has generated a savings of more than $100,000 annually in feed cost for the participating dairy producers. Productivity per cow on DHIA (70 percent) increased 3,000 pounds during the past decade.

In 1989 there were 14 dairy herds with average herd milk production of more than 20,000 pounds per year. This compared with 11 in 1988 and one in 1980. Dairy Extension educational programs on profitable and efficient production for survival in the nineties have been conducted throughout the state.

Forestry Management Systems

Extension forestry coordinated the Sale Layout and Harvesting Institute for USDA Forest Service foresters and engineers for the sixth year. The training has involved 36 weeks and has had 190 attendees from every National Forest in the eastern United States. It has generated $440,000 in revenue.

A two-week silviculture workshop held for Forest Service silviculturists for the past nine years has been coordinated by Clemson Extension forestry for the last four years. More than 100 students have attended the course. Another two-week short course was developed for Forest Service wildlife and fisheries biologists and silviculturists. This is part of a national project with courses at Clemson and at Oregon State University. Clemson has the potential for 24 students a year for 10 years.

Training materials were developed, and a series of best management practices training meetings has been initiated to train loggers and foresters on the effects of harvesting and road building on streams, water quality and soils. A statewide organization was formed to handle the arrangements for the 14 meetings planned across the state and to raise $12,000 for these meetings. The first eight meetings attracted about 475 persons.

In conjunction with Extension forestry promotion of the proper use of wood, four training meetings were held on wood characteristics for building, installation of wood products, and designing to avoid problems with wood products. The meetings for
builders, architects, building inspectors, mortgage lenders and Clemson Extension agents drew about 150.

A $20,000 grant was secured through the Clemson Extension integrated pest management committee to develop videotapes on how to avoid moisture-related wood decay and insect problems in houses. Five tapes are being developed with faculty members in forestry, home economics, building science, entomology and agricultural engineering.

A two-day "Pine Regeneration and Forestry Herbicides" Workshop was conducted to train more than 100 professional foresters involved with pine regeneration under the Conservation Reserve Program. Based on current prices, lands in this program will generate more than $250 million in gross revenue. Assuming that training will increase productivity by at least 2 percent, the workshop could potentially generate $5 million by the end of a 30-year rotation.

Home Food Production

Home food production is important to South Carolinians who relate it to nutrition, family budgeting, leisure time activities and agribusiness as well. Sixteen Clemson Extension specialists from five University departments and 98 agents from 40 counties are participating in the program.

Accomplishments in the home food production area for the year (as reported by 29 counties, the horticulture and entomology departments, and the Extension home food production program team) follow:

• 15,611 families received information on home food production (up 41 percent over the previous year).
• 3,992 families supplemented their diets and budgets with home-grown plant and animal foods.
• 1,969 people were trained in pesticide management and safety.
• 343 garden center operators and master gardeners were trained in home food production management.
• 1,674 4-H youth were involved in activities to develop home food production skills.
• 1,208 families marketed home-grown foods directly through local and state farmers markets, contract sales, pick-your-own markets.
• 12 garden grants of 250 each were awarded to community gardens, 4-H clubs, schools, mental health centers and rehabilitation centers in 12 counties.
• The home food production team budgeted $2,600 to buy pressure canner testers and food preservation equipment. Testers were bought for 18 counties who were not equipped to test canners. These testers assure homemakers and consumers that foods canned under pressure are safe to eat.

Horticultural Crops Management Systems

This team initiated several new commercial production publications in ornamentals and fruits.
The Postharvest Management Handbook provides information on fruits, vegetables, flowers and nursery stock. The Bedding Plant Production Guide provides comprehensive cultural information for the largest segment of producers in the floriculture industry. The importance of fertilizer management and production of high quality nursery stock is reviewed thoroughly in Nutrition of Container and Field Grown Nursery Crops. Weed Management in Ornamental Plantings provides detailed information on weed control, herbicide application and weed identification.

Two computer software programs have been completed this year: the Landscape Job Cost Estimator and the Greenhouse Enterprise Budget Calculator. These will assist ornamental businesses in making important financial decisions. A new Conversion Charts of Weights and Measures is a valuable desk reference for producers in all facets of horticulture.

Training for Clemson Extension agents this year emphasized pest management in turf, an important component of managing the sizable golf course industry in the state. Southeastern states cooperated this year to conduct the first multi-state fruit agent training in order to provide more uniformity in recommendations for commercial fruit production.

Land and Water Resources

This team is made up of a cross section of the professional staff of the Clemson Extension Service. Some issues addressed by this team are non-point source pollution, ground-water contamination and water quality education for youth.

One team goal was to provide training for Clemson Extension county agents on the provisions of the 1985 Farm Bill. This training has now been completed, and all of the counties have conducted training or provided it to farmers or to 10,000 landowners. Affected farmers are in the process of carrying out the provisions of the farm bill. Three projects dealing with water quality were funded through a grant from USDA during the year.

Ground-water pesticide applicator training was completed this year using a teleconference and county training modules. This training provided pesticide applicators information on how pesticides behave in nature and how some can move with water through the soil.

An in-school enrichment water quality curriculum for grades 4-6 was developed and tested in four schools. This was part of a project on food and drinking water safety. A project on waste disposal implications for water also was begun. This project deals with the proper disposal of pesticide containers and other hazardous materials.

Livestock Management Systems

Cash receipts from commodities are reported about one year late due to data collection. In 1987 income from cattle and calves ranked second in the state at $116,069,000.
## S. C. Cash Receipts From Commodities 1985 — 1987

<table>
<thead>
<tr>
<th>Commodity</th>
<th>1985</th>
<th>1986</th>
<th>1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>$167,498</td>
<td>$111,955</td>
<td>$149,140</td>
</tr>
<tr>
<td>Cattle &amp; Calves</td>
<td>78,873</td>
<td>93,369</td>
<td>116,069</td>
</tr>
<tr>
<td>Dairy Products</td>
<td>90,530</td>
<td>85,465</td>
<td>83,967</td>
</tr>
<tr>
<td>Soybeans</td>
<td>129,922</td>
<td>85,840</td>
<td>82,568</td>
</tr>
<tr>
<td>Broilers</td>
<td>65,377</td>
<td>80,006</td>
<td>72,134</td>
</tr>
<tr>
<td>Eggs</td>
<td>67,246</td>
<td>74,155</td>
<td>69,507</td>
</tr>
<tr>
<td>Hogs</td>
<td>57,604</td>
<td>58,099</td>
<td>68,972</td>
</tr>
</tbody>
</table>

Income from hogs ranked seventh, and combined income from cattle and hogs would easily take first place with $185,041,000. During the years shown, income from the red meat commodities are the only ones showing an increase each year, with cattle being the most substantial.

Drought conditions have forced extra animals through markets, and this has an impact upon income. Educational programs and events have had an influence upon the quality of meat produced. Yearly field days at the Clemson University Animal Science farm and at the Pee Dee and Edisto Research and Education Centers also have had an impact.

Cow-calf clinics and mini conferences at Anderson, Chester, Darlington and Walterboro have influenced the adoption of better breeding, nutrition and marketing programs.

South Carolina now has a monthly publication that reaches thousands of cattlemen, *The Carolina Cattle Connection*. This publication is produced by the Cattlemen’s Association with educational materials supplied by Clemson Extension, teaching and research professionals.

The Junior Beef Round-Up for youth continues to grow. In 1988, 150 youth with 220 heifers participated. In addition to youth, nearly 60 adults helped with hauling, organizing the show and with the stockman’s contest. This family affair, only in its second year, is extremely popular and appears certain to grow in the coming years.

### Marketing, Packaging and Utilization

The objectives of this program are to provide methods by which South Carolina’s people and industries can improve quality and productivity in the food processing industry. This issue is critical to South Carolina since 20-40 percent of sales dollars in food processing is lost through waste. This is an annual loss of $350-700 million for the state’s food processing industry.

To cut this loss, Clemson Extension food scientists developed a quality and productivity improvement program for the food processing industry. More than 150 professionals have been trained in various principles of quality improvement. This program was reported in a food processing trade magazine, which reached more than 200 food processing companies in South Carolina. As a result of this program, improvements have been made in quality and productivity.
SO-PAK-CO of Mullins is an example of the success that can be achieved by applying the principles of quality improvement. During the first year, the company experienced an increase of profits of more than $100,000 specifically from quality improvement resulting in less waste. SO-PAK-CO produces military rations for the Department of Defense. Defense department officials have credited SO-PAK-CO with having the best quality improvement program in the military ration industry. In this case, Clemson Extension Service has helped a South Carolina food processing industry compete effectively in quality improvement.

Peaches are South Carolina’s number one fruit crop. Up to 25 percent of the crop is graded as No. 2 peaches because of improper maturity, blemishes or size. Extension food scientists have demonstrated a new use of discarded peaches. They paired an apple juice processor with several peach producers so 500 tons of No. 2 peaches from the Ridge area and Spartanburg County could be used to produce a new product for the Southeast — a pulp-free peach concentrate. The peach concentrate is a dark golden syrup that can be used as a base for blended juice products, carbonated sodas and wines, and as a natural sweetener for jams and jellies. In turn, the processor has blended the peach concentrate with apple and pear concentrates to create a “fruit cider” that has been successfully test-marketed.

Catfish production is an emerging agribusiness in South Carolina. Future growth of the industry will rely, in part, on the availability of suitable facilities to dress, process, package and market catfish products. Extension food scientists conducted an in-plant packaging demonstration of equipment, procedures and materials required to competitively market catfish products. In addition, seafood processors were shown a pilot plan demonstration on packaging techniques to individually vacuum package frozen whole golden crabs, shrimp and crab meat in plastic films. Other demonstrations assisted a processor in developing and marketing two new seafood products using South Carolina catches (canned squid rings and canned whole conch meat in sauce) for export to countries along the Asian-Pacific rim.

Effective use of state resources is a major thrust. An example of the use of internal resources is shown by Clemson Extension assistance to Industrial Micro Systems. This South Carolina company manufactures process control equipment. Although their equipment was not directed toward the food processing industry, Clemson Extension specialists helped with the modification of equipment for food processing. Another example of Extension assistance includes help with in-plant trials of South Carolina egg products in a South Carolina food processing plant.

Clemson Extension food scientists provided 36 technology transfer advisories to more than 30 South Carolina food processing operations; helped five new food processing ventures get started, provided another 31 technical advisories to prospective venture groups/individuals; and disseminated 94 food regulation memorandums advising an average of 52.72 commercial food processing operations (per memorandum) on new or changed regulations. This enables them to understand regulations designed to protect the food supply.
Farm Management, Marketing and Agricultural Policy

- Financial management, marketing and policy (disaster) alternatives were provided to farmers and agribusinesses affected by Hurricane Hugo. Estimates of agricultural losses from Hugo were provided to policy-makers, agencies and the media.
- Through the Clemson University Management Assistance Program (CUMAP), individualized financial management planning was provided to 75 farm families needing assistance with refinancing or bankruptcy.
- A simplified record-keeping system was provided for small farmers. This program is in its second year, and more than 100 small farmers are using it. A grant was obtained from the USDA-Extension Service to expand and enhance this program.
- Six tax schools were conducted for 950 tax practitioners. The schools focused on losses from Hugo and new tax law changes.
- A grant was received from Extension Service-USDA to start a new farm management association in Orangeburg, Calhoun, Bamberg and Hampton counties. It will be the state’s second.
- Farmer marketing clubs were begun in Orangeburg, Calhoun, Sumter and Aiken counties. Interdisciplinary marketing meetings were held for field crops, vegetables and fruits.
- Interdisciplinary livestock-forage programs and demonstrations were provided to 500 producers. These emphasized alternative production-management practices, which contribute to the long-run sustainability of agricultural resources.
- Public policy training and meetings were conducted on issues relating to the 1990 Farm Bill. These issues included farm programs, conservation, water quality and food safety.

Agricultural Engineering Department

Energy audits were completed on 15 irrigation pumping units. Potential energy savings ranged from 5 to 54 percent on the units tested, with the average being 10 percent. A program for computing the efficiency of the systems was completed and is being used. Farmers in nine counties who have irrigation equipment now have a better idea of the efficiency of their pumping units and the potential savings in energy and money.

Energy audits were done on more than 100 greenhouses and 25 vegetable coolers. Potential energy savings range from 10 to 20 percent. A demonstration of under-bench heating in a greenhouse was installed and data collected for a publication this fall. A publication on an over-wintering system for South Carolina nurserymen was made available last year.

The low energy swine production facility plan was finalized and made available to South Carolina swine producers. Low energy systems can cut production costs and improve performance.

A prototype multi-pass cucumber harvester was field tested. Additional refinements are needed before it is ready for farm use.
The 4-H "Get Fired Up!" fire safety program is now educating more than 20,000 fourth, fifth and sixth grade students throughout South Carolina. This program continues to offer new materials designed for teachers to use in classrooms with the help of local 4-H agents and fire professionals.

The Agricultural Weather Office prepared daily weather forecast tables, which were posted on the CUFAN system and forwarded to each county. Climatological information developed from records maintained by the office was supplied to users upon request. Weekly summaries of evaporation and soil temperature were used in the USDC/USDA Weekly Weather and Crop Bulletin.

Housing affordability problems and new financing processes produced high demand for information on this subject. A six-month correspondence course, "Buying a Home," addresses this problem.

Extensive roof damage and resulting repair contracting problems between homeowners and repairmen were addressed after Hurricane Hugo through a series of 11 informational leaflets and numerous news articles.

The Clemson University Housing Institute, a multi-discipline unit, made available grants of about $2,000 each to several Clemson Extension offices and to several departments on the Clemson campus to carry out demonstration and education programs. These programs ranged from building displays for home shows to providing travel to and from meetings. The Housing Institute has been reorganized and is on the way to achieving its goals. Last year the following Extension projects were funded:

- Tabletop Moisture Control Exhibit/Integrated Monitor/VCR—Dorchester County.
- Three Moisture Control Exhibits—Beaufort County.
- A Home Buyer’s Seminar—Florence County.
- Kitchen Design, Planning and Storing—Chester County.
- Tabletop Moisture Control Exhibit—Pickens County.
- Evaluating House Designs: Software Computer Seminars—York County (to enhance efforts for the homeless).

Agronomy Department

Clemson Extension agronomists have implemented educational programs addressing issues such as water quality, food safety, waste management, and the short- and long-term ecological and economic sustainability of agriculture in South Carolina.

A database is being established to determine the present environmental situation and subsequent changes in production practices needed to maintain or improve water quality. Reducing agricultural chemical (fertilizer and pesticide) inputs is also a major issue being addressed. Clemson University’s Agricultural Services Laboratory has been used extensively by growers to guide them in the use of plant nutrients to assure adequate production levels with minimal environmental impacts. Herbicides account for 80 percent of the agricultural pesticides used. Programs have emphasized use of cultural and mechanical weed management practices to minimize dependence upon herbicides. Also, intensive educational efforts covering weed identification, herbicide
efficacy, and crop and weed responses to herbicides have encouraged judicious use of herbicides to preclude unnecessary applications, overapplication or unacceptable weed control. Waste management programs have emphasized application of wastes in an economically and environmentally sound manner. To facilitate information delivery in these areas, on-farm demonstrations and tests, county or multi-county meetings, statewide meetings, tours, field days and training sessions have been conducted. Total clientele exceeded 2,500 growers, agribusiness representatives and other agriprofessionals.

The welfare of the agricultural economy centers around profitability, which is driven by production levels, quality of the final product and effective marketing. Cash receipts from South Carolina’s agronomic crops exceed $380 million annually, with the majority (95 percent) coming from tobacco, soybeans, corn, cotton and wheat. Therefore, Clemson Extension agronomy programs emphasize economically and environmentally sound production systems for these crops. Variety selection, pest management, nutrient management, tillage systems and rotations have received considerable attention in efforts to help growers achieve profitable production levels.

Extensive efforts have centered around successfully producing alternative agronomic crops in the state. Extension agronomists published several production guides for new crops and have conducted on-farm demonstrations, production meetings, and a statewide tour and field day to provide growers with information concerning successful production of canola, flax and triticale.

**Entomology**

Much has been said and written about the boll weevil eradication project, which this department has helped carry out for the past eight years. But few people realize how successful this program has been. Some statistics on the program include:

- South Carolina cotton acreage has increased from a low of 69,000 acres in 1983 to more than 160,000 acres in 1990.

- Insecticide applications have been reduced from 20 or more per season to 5-6 per season. This has saved farmers money, reduced insecticide in the environment by as much as 75 percent and has made Integrated Pest Management a standard practice in cotton production.

A major success in the Clemson Extension entomology program has been the training and educational programs for the pest control industry. Two significant accomplishments achieved in 1990 were:

- The thirty-first Clemson Pest Control Operators School in February of this year had the highest attendance of any single state PCO conference in the United States. More than 750 pest control operators attended.

- The first professional termite technician training program in the United States was established at the Sandhill Research and Education Center. Technicians are given detailed training in the proper use and application of termite controls. Graduates earn recognition as master termite technicians and receive a distinctive patch. This program helps upgrade industry standards for termite treatment and ensures better protection of homes from termites.
Horticulture Department

Horticulture sponsored a record number of grower education programs last year. Programs were conducted by horticulture specialists in conjunction with the S.C. Nurserymen’s Association, the S.C. Landscape and Turfgrass Association, the S.C. Greenhouse Growers Association, and members of the golf course and sod producing industries.

The National Peach Council held its national meeting in South Carolina last year, and the Horticulture Department helped organize the program. A new kiwifruit growers association was formed, and a kiwifruit educational program was organized.

A meeting of South Carolina Master Gardeners was held in conjunction with the annual meeting of the S.C. Horticulture Society. Additionally, an advanced training session for Master Gardeners held on the Clemson University campus was well attended.

Agent in-service training sessions were conducted on home grounds problem identification, commercial vegetable production, commercial turfgrass production and small fruit production.

The department is placing major emphasis on computer applications. Using a departmental computer laboratory, an in-depth session on computer-assisted landscape design was held. A computer applications demonstration held at a meeting of South Carolina nurserymen drew many favorable comments. A training session was held to teach Extension agents the Macintosh system and peripherals, including laser printers and a digitizing scanner used to create high quality desktop publications.

The Horticulture Department cooperated with the Agricultural Communications unit in buying, setting up and operating an interactive video kiosk in the Clemson Ag. Sales Center. This prototype unit is being used to provide timely information about all aspects of Extension programs and is used to study response to the CU Extension videodisk.

In addition to newsletters and other Extension publications, a new type of material has been created and printed this year. The home grounds fact sheets and the home garden leaflets are designed to provide information about landscape features or production information.

Extension horticulture specialists are beginning to obtain visibility and experience in international horticulture. Two specialists accompanied South Carolina growers on a trip to Chile, a tree fruits specialist visited fruit producing areas of Egypt, Clemson’s fruit postharvest specialist presented a paper at a meeting in Mexico, one individual made a trip to the fruit areas of Italy, and a vegetable specialist made two visits to China. Their experiences will be valuable in working with producers entering the international market place.

Plant Pathology and Physiology Department

The Plant Problem Clinic administered by this department made more than 3,000 diagnoses for growers and homeowners last year. The dollar value of this service is high for the amount of input. Each pesticide application or non-application represents real dollars. An accurate diagnosis and recommendation can mean the difference between profit and loss.
Field crops represent the largest dollar volume lost to plant diseases and the largest amount of pesticides used. For instance, soybean yield averaged about 10 percent less because of nematodes and about 7 percent less because of plant diseases. Extension recommendations, services and education programs keep this loss at about half of what it would be if no controls were used. This represents a grower savings of about $3 million annually. The savings for peanuts, tobacco, vegetables and fruit is collectively much larger.

A relatively small but successful education and demonstration program was used to assist growers of processing peaches with a fruit rot problem. Growers became aware of the control inputs needed and are successfully producing a crop with little or no pesticide residues.

**Poultry Science**

The Clemson Extension poultry program has continued to address the major industry concerns of improving the environment in production facilities. A cooperative agreement with the industry resulted in the development of a low cost winter ventilation system for commercial producers. This new system allows producers to improve the air quality during cold weather without expending extra fuel for heat. Improved air quality will result in less disease and improved production, providing the contract producer and the poultry company with greater financial returns.

A workshop on the importance of disease control provided educational materials and training on the South Carolina Poultry Improvement Plan. Participants who were tested and certified as agents of the plan during this workshop will assist with the many disease control programs in place in the South Carolina poultry industry.

The youth program in poultry has been greatly expanded, resulting in increased participation by Clemson Extension personnel in the counties. 4-Her’s were exposed to many facets of the poultry industry and its products through the various poultry programs. Major emphasis on food safety has provided young people with proper guidelines for the preparation of poultry products and a better understanding of the importance of food quality.

**Strengthening the Family**

**Family Life Education**

Parenting education was selected as the major focus of this team. Materials developed for parents of teens included the following: development, communication, goal setting and forming support groups. Forty home economists were trained in the new curriculum. In addition, programs for parents of children up to age four and programs for parents of children 5 to 12 years old were supported by the family life education team and state staff.

Family court judges are recommending that abusive parents attend these programs. Staff from other agencies also are being trained to conduct the programs.

In the past year 8,695 parents have said these programs helped them improve their parenting skills, 6,397 parents claimed the programs increased their child development
knowledge, and 4,686 parents reported they will show more affection to their children as a result of the programs. In addition, many parents obtained information about parenting through mass media or received the information in a mailout series and were not asked to report.

The Children and Adult Resource Express (CARE) database and referral system for families with dependent children under 17 and dependent elderly over 55 was maintained, updated and improved. This database has information about service-providers, services, educational opportunities, legislative information and demographics. The number of times it is being used is increasing. For example, in February 1990, 4,200 pages were accessed.

**Family Resource Management**

During 1988-89 this team developed and supported statewide programs designed to help people improve their financial stability by gaining and maintaining control of finances and other resources throughout their lifetime.

Thirty-seven counties have planned and conducted "File It, Find It" programs reaching more than 1,500 participants. About 25 percent organized a home filing system. Participants estimated by being better organized they could save an average of 10 hours a month. "In addition to a marriage license and premarital counseling, 'File It, Find it' should be a prerequisite to marriage," one participant said.

An additional 4,300 South Carolinians attended programs designed to help them use resources to ensure financial security. Of those participating in goal-setting programs, 85 percent set financial goals for themselves for the coming year. About 1,800 young people participated in career exploration programs, and 200 gained skills in financial planning and organizing.

Special emphasis has been placed on encouraging couple participation in financial management programs to ensure better follow-through on family financial planning. Couple participation in financial management Extension programming last year increased 122 percent over the previous year.

**Housing**

As the S.C. housing industry and Industry Advisory Council work with Extension to prevent costly home damage from excessive moisture, citizens are realizing significant savings. Avoiding such costly damage preserves the state's real estate tax base.

Twenty-one counties report the following accomplishments in the first nine months of the year:

- 238 existing homes were altered to correct or prevent moisture damage.
- 44 new homes were designed or built to avoid moisture problems.
- People saved more than $74,000 from preventive or corrective actions.
- 1,016 industry professionals (appraisers, builders, realtors, pest control operators) used Clemson Extension training to identify, prevent or correct problems.
- 297 trained lay leaders taught other citizens how to avoid home moisture damage.
Thirty-six counties reported that more than 29,770 South Carolinians requested help in identifying, preventing and correcting home moisture damage — a major Extension educational program for 1987-91.

Extension professionals also helped citizens in other areas of housing. Five counties reported helping 123 homeowners improve fire safety, air and water quality, and energy conservation. Three homes were built or altered to be accessible by elderly or handicapped people. Four homes and 10,754 square feet of new or remodeled space were built using Clemson Extension help. Eight families added, improved or reorganized storage. Eight clients improved home pest control, saving $200, and two families selected alternative housing.

One county reported 29 homeowners renovated the exterior of their homes using Extension help. More than 10,960 citizens in 25 counties sought Extension information on topics other than home moisture control, including 61 who learned how to buy a home at a nine-hour workshop in three locations co-sponsored by Extension, the Clemson University Housing Institute and the Clemson University Building Science Department.

Developing Human Resources

Health and Wellness

Local teen pregnancy prevention councils are active in 32 of the 46 S.C. counties. Extension leadership has been instrumental in securing $250,000 in private funding to support activities of these local councils. The funds are used to hire coordinators, to set up teen health clinics, to provide recreational activities for young people and day care for children of teen parents, for parent education, to conduct youth health fairs, and for other ongoing activities of the councils.

The local councils are under the auspices of the State Maternal, Infant and Child Health Council of the Governor’s Office. Extension provides major leadership to the state council, as well as most of the local teen pregnancy prevention councils, and is networking with 900 state, local and federal groups to address the issue.

Extension programming in the area of stress and health took an unexpected turn when Hurricane Hugo hit the state. Information on common reactions to disaster and significant loss, as well as steps in helping and providing emotional support, went to more than 20,000 of the hardest hit residents immediately following the storm. This information was in the form of a printed pocket-size card.

With the increased number of children facing stress due to serious illness, moving, divorce and the like, Clemson Extension offices in the counties are working with schools to address the needs. For example, in Florence and Barnwell counties, Clemson Extension agents conducted teacher in-service training programs on helping children handle stress. Fairfield County supplied this information to all assistant principals and guidance counselors.

Books help children gain insight and provide ways to cope with stressful events in their lives. More than 500 doctors, health care providers, nurses, social workers and others who work with children have received a resource folder on children's books and how to use them to help children and parents cope with stressful situations.
More than 12,000 adults throughout the state participated in Extension educational programs on coping with stress, with 1,800 reporting they adopted coping skills to improve their health.

Nearly 3,000 parents have participated in Baby Talk, a newsletter series for new parents. Participants say they spend more time with their children as a result of the series.

Funding from the South Carolina chapter of the March of Dimes enabled the Clemson Extension Service to train teams of health-care providers and Extension agents from 27 counties in a worksite prenatal wellness program. Industries are currently being contacted and educational sessions with employees offered.

**Human Nutrition**

Clemson Extension human nutrition programs continue to receive major emphasis. Work was planned under two headings: (1) consumers making wise food choices and (2) the safe handling of food. County Extension agents worked with more than 755,000 South Carolinians in these two major thrust areas.

Under the first, 185,000 persons received information on how to plan balanced meals; 2,000 adopted new, positive eating habits; 252,000 learned the relationships between nutrition and chronic diseases such as cardiovascular disease, cancer, stroke and hypertension; 130 participants in the Diet Puzzle Weight Control Program lost 12 pounds or more during the 12-week lesson period; 49,000 people learned to evaluate food and nutrition information that they see in the media; and 67,000 developed skills in healthy food preparation methods.

The safety of the food supply is an emerging concern for consumers. This team is placing emphasis on the safe handling of foods, the safe preservation of food at home and the quality of the food supply. There is a lack of understanding of the interrelationships within the food system from production to consumption. Consumers need to understand factors that influence the quality of the food supply and their responsibility in maintaining the safety of the food they eat. More than 200,000 consumers received information on these subjects last year from the Clemson Extension Service.

**Human Nutrition (EFNEP)**

The Expanded Food and Nutrition Education Program (EFNEP) is a federally funded program administered in South Carolina by the Clemson Extension Service. Its primary purpose is to improve the diets of limited-resource families, thus enabling them to enjoy better health, improved stamina and increased productivity. About 16 percent of the state’s population (303,233) has income in the “below poverty” category.

Last year 4,100 limited-resource homemakers were reached through the EFNEP Adult Phase in 41 South Carolina counties. About 40 percent of them graduated in 12 months or less by reaching a designated level of proficiency in relation to food, nutrition knowledge and food practices. About 90 percent of those enrolled showed improvement in their diet and food handling practices.

About 5,700 youth were involved in EFNEP last year. They learned how to make wise food choices, how to prepare nutritious snacks and simple meals, and how to
handle food safely. The majority of them participated in community groups led by volunteer leaders. About half also participated in regular 4-H activities or stayed in 4-H after graduation from EFNEP.

About 800 volunteers contributed 9,000 hours to EFNEP. EFNEP homemakers were informed of services of other agencies, especially those related to health and nutrition. There has been a continual increase in the number of referrals to EFNEP from other agencies in the past two years.

Leadership

The leadership program team is working toward three primary objectives: (1) enhance networking of public and private agencies and individuals working to develop local leadership potential; (2) develop a leadership training system which enables citizens to develop personal and group leadership skills; and (3) develop mechanisms for professional staff to work effectively with local people.

The primary effort related to objective one has been absorbed within the objectives of the Palmetto Leadership Project. The Leadership Consortium held its first meeting in spring of this year with a cross section of leadership specialists from Clemson University, state government and private agencies. As this state leadership consortium evolves, efforts will be made to establish local leadership consortiums.

To achieve objective two, a series of workshops designed to enhance skills of personal and group leadership empowerment was offered to professionals and volunteers. This training included two phases and carried with it an expectation of at least 20 hours of volunteer service to be contributed by volunteer participants. This has resulted in significant accomplishments initiated by trained volunteers in several counties. Based on follow-up evaluation reports of time and contacts from the volunteers, more than 10,000 hours of volunteer service have been given to local communities, with more than 8,000 people reached through efforts of the volunteers.

More than 40 professionals and volunteers toured two states, Ohio and Pennsylvania, which have demonstrated strong volunteer involvement in community action Extension programs. Half the counties had representatives attend training on developing and managing strong advisory and program committees this past year. This training resulted in an assessment of current operating procedures in these counties and the development of new efforts to develop more effective and efficient program committees. Efforts are being made to help these counties record and report volunteer contributions through the use of a computerized volunteer management system being developed on the Clemson University campus.

Youth Development

The Youth Development and 4-H program is the youth educational component of the Clemson Extension Service. It is community-based and led by volunteer support. More than 56,000 young people and 3,000 volunteers took part in the educational outreach program of Clemson University in 1989-90.

The goal of the program is to help young persons become competent, contributing members of society who are able to cope with societal challenges. Because today's society offers youth innumerable challenges, both positive and negative, Extension is
taking a lead role in teaching life skills and in preventive education. Effective programs have been developed and offered on drug and alcohol abuse, career education, communication and relationship skills, leadership, development of a positive self-esteem, and management of human and nonhuman resources.

In addition to science and technology, technical skills are being taught in other areas of food and agriculture. Young people have learned decision-making skills, advocacy skills, and actively participated in community government processes. Peer counseling, countywide speak outs and agency collaboration can be documented. Teen involvement in citizenship celebrations, county beautification projects and preservation of natural resources has increased. Because of the importance of family life in positive growth and development, efforts in understanding one’s heritage have also been promoted.

Developing Communities

Rural and Community Resources

Clemson Extension agents serving 35 rural counties this year improved their abilities to address rural and community resource problems by attending a two-day training program on “Planning for Community Growth and Economic Development.” The training was conducted by Clemson Extension specialists and experts from other Clemson departments and relevant state agencies.

Three workshops on how to establish bed and breakfast businesses drew 155 participants. A publication, Beginning Bed and Breakfast in the South: Guidelines for Development, also has been published.

The Palmetto Leadership program was expanded to six more counties while continuing to provide educational and technical resources in the four pilot counties. Training seminars on a variety of leadership and economic development topics were presented by University faculty and other resource specialists. To date, more than 500 persons in 10 counties have received training through this program. In counties initiating phase two, 35 task force groups have been formed to address priority local issues. Among issues being addressed are quality of life, solid waste reduction, community health, recycling, local-option sales tax, infrastructure needs and school consolidation.

Clemson Extension supports the Governor’s Community Improvement Board and the Parks, Recreation and Tourism Commission through organizational maintenance for county community improvement councils and committees. Litter education programs are conducted for young people through poster contests and in-school curriculum resource materials. More than 2,000 elementary and high school students took part in this year’s poster contest. Thirty-eight community improvement groups were assisted by Clemson Extension in meeting criteria for awards presented at the Governor’s Annual Community Improvement Awards Banquet.

County agents and volunteers from eight counties participated in training co-sponsored by Clemson Extension and the American Association of Retired Persons to expand the WORKS program. This program improves job search skills for mid-life and older persons. Since the training, four counties have implemented the program and trained 56 persons. Of these, six have found jobs, three are seeking additional schooling, and others are in various stages of the job-seeking process. A survey of participants in
Orangeburg County, where the program was first used, found that 53 percent of those trained have found employment. Others were seeking employment or engaged in additional training. Ninety-three percent of those surveyed said the program had been helpful and they were using the skills they had learned.

Additional activities in rural and community resource development include the initiation of a newsletter, *Issues in Community and Economic Development*, and a study to determine the characteristics of rural communities that have been successful in attracting foreign firms, and the impacts these firms are having on the host communities.

**DIVISION OF REGULATORY AND PUBLIC SERVICE PROGRAMS**

The Division of Regulatory and Public Service Programs, which began in 1970, consists of the director's office and four departments: Fertilizer and Pesticide Control, Plant Industry, Seed Certification and a portion of Agricultural Chemical Services.

The division's mission is to ensure compliance by regulated industries and individuals with legislative mandates and regulations. The division also provides its target audiences assistance and services to educate and achieve compliance.

Division programs promote the use of certified seeds and plants; provide the services needed for certification of crops and plants; assure that fertilizers, lime, pesticides and seeds meet the standards to produce marketable, safe and profitable crops; provide inspections to monitor pesticide treatments by the pest control industry; and provide inspection to assist the state's plant industry in maintaining plant material and agricultural commodities apparently pest free.

The following activities, by department, highlight the division's work for 1989-90.

**Department of Fertilizer and Pesticide Control**

The Department of Fertilizer and Pesticide Control is responsible for education and enforcement of the provisions of a number of laws and regulations. The South Carolina Fertilizer Law and the Liming Materials Act are primarily designed to ensure that consumers receive high quality fertilizer and lime. The Pesticide Act regulates pesticide storage, sale, use and numerous other areas such as quality control and structural pest control.

Some of the major activities of this department relative to fertilizer and lime from July 1, 1989, to June 30, 1990, follow:

- **Fertilizer tons sold** ........................................ 522,182
- **Fertilizer samples procured & analyzed** ................ 4,344
- **Fertilizer samples not meeting guarantee** .............. 664
- **Lime material & samples procured & analyzed** .......... 167
- **Total number of liming material samples not meeting guarantee** ........ 3
- **Percent of liming material samples deficient** ........... 1.8%
- **Fertilizer penalties collected, payable to State Treasurer** ** ........** 25,237.92
  (Deficiencies where consumers not identifiable)
Lime penalties collected, payable to State Treasurer** ..................... 1,453.32
(Deficiencies where consumers not identifiable)
Fertilizer registration fees collected, payable to
State Treasurer** .......................................................................... 23,970.00
Lime registration fees collected, payable to State Treasurer** ............ 700.00
Lime permit fees collected, payable to State Treasurer** ................. 1,620.00
Fertilizer taxes sent to State Treasurer** ......................................... 130,306.84
Fertilizer civil penalties .................................................................... 50.00
Soil amendment fees ........................................................................ 155.00

**Actually recorded by State Treasurer July 1, 1989-June 30, 1990, but may not correspond to final fees paid for the fiscal year.

The fertilizer tonnage sold this year was up slightly from 1988-89. Overall 15.3 percent of fertilizer samples did not meet the guarantees within the investigational allowances. This deficiency rate fell from 1989-90. Other than deficiencies, the greatest problem in the fertilizer and lime areas continues to be the lack of proper labeling of bulk material.

The South Carolina Pesticide Control Act mandates quality control monitoring and regulates the sale, use and application of all pesticides used in South Carolina. This department uses a strong preventive education program coupled with fair enforcement actions when necessary to help ensure productivity while preventing adverse effects on man or the environment.

In an effort to improve its education and enforcement capabilities, this department has pursued external funding sources without decreasing the flexibility of the pesticide program. These efforts have resulted in a $371,300 grant from EPA. The department also has made a concerted effort to increase efficiency by using state-of-the-art data management. All fees collected under this act are sent to the State Treasurer.

In 1989, 780 companies registered 7,643 pesticide products for sale in South Carolina. The department collected and analyzed 632 pesticide samples. Inspectors found three deficient in the guaranteed percentage of one or more ingredients and issued stop-sale notices. The department collected $133,283 in registration fees.

Using provisions of the Federal Pesticide Control Act, the department issued four Section 24 (C) special local need registrations. The EPA granted the only Section 18 emergency exemption solicited by the department.

Pesticide dealers and applicators must be certified and licensed to buy sell or apply pesticides classified for restricted use. Last year, the department issued 12,247 private applicators licenses, 2,081 commercial applicators licenses, 933 noncommercial licenses and 364 pesticide dealers licenses. Certification fees collections totaled $92,465.

In the area of education and enforcement, the department’s specialists made frequent contact with pesticide users, including dealers, growers, applicators and consumers. The structural pest control area requires particular attention. The Pesticide Act was amended to strengthen regulatory efforts. Dealer inspections and meetings with pest control operators were necessary to assist this transition. The department has drafted regulations for the structural pest control industry which were mandated by the Chemigation Act.
Enforcement actions against violators were decisive but fair. As part of the EPA/Department of Fertilizer and Pesticide Control Cooperative Enforcement Grant, the department made 100 marketplace inspections, 200 certified applicator record checks and 300 restricted-use pesticide dealer inspections.

The department levied 51 civil penalties ranging from $50 to $1,300 and totaling $11,000. Three criminal prosecutions resulted in convictions. Investigators pursued 610 cases of potential pesticide misuse or noncompliance with regulations. They issued numerous stop-sale notices for unregistered products, sale of restricted products by unlicensed dealers and other alleged violations. The department issued warning letters in 155 cases. Overall compliance with the act by members of the agribusiness industry has been excellent.

The department’s regulatory programs sent $420,241 to the state treasurer.

**Plant Industry Department**

The department prevents the introduction and spread of plant and honey bee pests into, within and from South Carolina by conducting regulatory programs. Activities for the year included:

**Nursery Inspections:** By provisions of the Crop Pest Act, the department licensed 631 nurseries, greenhouses, and vegetable transplant growers and 1,007 nursery dealers to sell plant material. Department specialists visited another 293 establishments to determine compliance with quarantines and plant pest regulations. Twenty-seven other nurseries failed seasonal inspections due to pests, weeds or other problems.

**Phytosanitary Certification:** The department facilitated the export of plant material by issuing 232 state and 33 federal phytosanitary certificates. The plant material included orchids, rooted chrysanthemum cuttings, propagated native plants, anthuriums and hardwood lumber. Plants were shipped to other states, Canada and 23 foreign countries.

**Special Inspections:** The department issued nine certificates of plant inspection for homeowners to move house plants to other states. This service is provided when the destination state requires house plant inspection. Florida-bound homeowners accounted for 78 percent of these requests. Thirty-seven Pee Dee tobacco transplant growers requested special inspections that permitted sale of about eight million transplants to North Carolina growers.

**Postentry Quarantine Inspections:** Department specialists conducted four postentry inspections for importers who received eucalyptus plants from Brazil, feijoa plants from New Zealand and rose plants from Great Britain.

**Phony Peach Disease:** Four temporary inspectors and three departmental specialists surveyed peach orchards in the Ridge and Coastal Plains areas for phony peach disease. Out of 1,283,100 trees inspected, 515 (0.04 percent) were destroyed.

**Sweet Potato Inspection:** Department staff made 33 pest detection inspections for 11 growers in the Pee Dee, Sandhill and Coastal Plains regions.

**Bee Disease Act:** Inspectors checked 77 apiaries comprising 2,623 colonies of bees for diseases. Tracheal mites were confirmed in 49 apiaries, nosema disease in nine
colonies, American foulbrood in two colonies and purple brood in one colony. No Africanized Honey Bee swarms were detected in the state this year. Varroa mite survey continued throughout the state as 132 apiaries with 4,751 colonies were checked. Nine percent of these colonies were sampled using the Apistan strip method, and no Varroa mites were detected.

*Neglected or Abandoned Orchards Act:* Abandoned fruit orchards cause an increase in pest problems for other fruit growers in the area. Under the act, compliance surveys and investigations of abandoned orchard complaints were conducted. The department achieved destruction of 320 acres of nuisance peach trees by 22 property owners and 15 acres of apple trees by two property owners.

*Cooperative State/Federal Programs:* The department and USDA renewed a cooperative agreement in 1989 providing for seasonal employees. The agreement created temporary survey and control activity jobs in the witchweed and gypsy moth programs for about 75 people.

*Witchweed:* Only 13,080 infested acres in four counties remain in South Carolina. Marlboro County was released from quarantine in 1989. This year 331 new acres were found, and 2,108 net acres were released from quarantine. Contractors treated 10,000 acres. Since the beginning of the program, 67,391 acres have been released.

*Gypsy Moth:* Trappers caught 261 adult male moths in 1989. Horry County accounted for 185 of that total. A spring *Bacillus thuringiensis* treatment of the small local infestation in Surfside Beach accounted for the drop in male moth catches over the last two seasons in Horry County.

*Boll Weevil:* The department administered the 1989 program with good results. A total of 1,010 cotton growers paid fees of $943,466.94, a 99.9 percent collection level. The General Assembly appropriated $200,000 to be refunded to cotton growers, which offset a portion of their fees. The refund amounted to $1.68 for each acre of cotton grown. Boll weevils were scarce in the eradication area, with only 10 reported for the year. The objective for 1990 is to completely eliminate the boll weevil from the state.

*Imported Fire Ant:* Interstate spread of the imported fire ant continues. Departmental activities consisted mainly of assisting nurseries, turf growers and other establishments to meet plant shipment quarantine requirements. Department personnel supervised specific regulatory treatments for this purpose.

**Seed Certification Department**

Seed certification is a program of standards imposed on the seed and plant production industries that ensures varietal purity, good germination and freedom from noxious weed seeds. Participation in the program is voluntary.

The General Assembly designated Clemson in 1945 as the agency to inaugurate and carry out a program of certification of pure seed and plants in South Carolina.

Department field work in 1989-90 involved inspections of 40,277 acres of crops for certified seed production. Inspections included 80 varieties of 14 crops for 155 farmer/
growers and 22 seed-producing firms. Inspectors checked each field to determine that the crop was true to variety and free of noxious weeds and seed-borne diseases.

Acreages of major crops inspected were soybeans, 22,176; small grains, 15,663; cotton, 848; peanuts, 730; turfgrasses, 384; and pine trees, 434. Other field work involved grow-out plantings of 232 samples of South Carolina certified soybean and small grains seed for comparison to the producers' or seed conditioners' samples of the same lots.

During 1989-90 the department issued 731,504 certified tags to growers whose seed met standards in the field and laboratory. Inspectors checked and approved 23 facilities during the year for custom conditioning of South Carolina certified seed.

**Agriculture Chemical Services**

This department performs the chemical analyses reported by the Department of Fertilizer and Pesticide Control. Most samples were multi-component, with more than 23,000 individual analyses made.

The laboratory has concentrated on improved methodology, instrumentation and organization to analyze all samples quickly and accurately. The department performed more than 39,000 analyses for the S.C. Agricultural Experiment Station during the fiscal year. In addition, the Agricultural Service Laboratory processed more than 79,000 soil samples, 5,200 plant and feed samples and 5,000 samples for nematodes.

**LIVESTOCK AND POULTRY HEALTH DIVISION**

The Livestock-Poultry Health Division conducts a number of regulatory programs in consumer protection, animal health and the diagnosis of various diseases in South Carolina livestock. The division's three main responsibilities are the administration of the South Carolina Meat and Poultry Inspection Programs, the Livestock Health Programs and the Diagnostic Laboratory.

**Meat and Poultry Inspection**

The South Carolina Meat and Poultry Inspection Department serves as a public health regulatory agency functioning within the guidelines of state and federal laws to ensure that meat and poultry products inspected by the department are safe, wholesome and accurately labeled.

A memorandum of understanding to standardize on-farm investigations of drug residue violations, reporting procedures and regulatory actions was initiated and finalized among the U.S. Department of Agriculture, U.S. Food and Drug Administration, S.C. Department of Agriculture and Clemson University. The four area veterinarians have been trained and accredited to conduct Sulfa-On-Site testing for sulfamethazine adulteration of hog carcasses.

The USDA conducted a month-long, in-depth review of the South Carolina Meat-Poultry Inspection Program and found the state program "at least equal to" the federal inspection program.
Approximately 110 meat and poultry plants are inspected periodically — depending on volume of operation — for plant sanitation and product quality. An active compliance program is in place to ensure that the department will continue to provide effective and efficient inspection services.

Animal Diagnostic Laboratory

Utilizing bacteriology, virology, hematology, histopathology, blood chemistry and many other laboratory tests, the laboratory diagnoses diseases and other problems in postmortem exams and on specimen submissions. This is a continuing service for companion animals and the animal industries through practicing veterinarians and directly to owners.

The laboratory also supports public health through investigation of mosquito-borne equine encephalitis, which may be fatal to horses and humans. Other diseases communicable from animal to man such as Chlamydia psittaci are reported to the S.C. Department of Health and Environmental Control. In cooperation with the National Poultry Improvement Plan, the laboratory is monitoring commercial egg breeder chickens for Salmonella enteritidis to protect against spread of this potential threat from other areas.

Equine Infectious Anemia (EIA) tests increased in 1989 to 9,781 with 40 animals tested positive. The number of these tests is expected to more than double in 1990. Pseudorabies tests on swine increased by 10,000 in 1989 to 13,555. This level is not expected to fluctuate in 1990. Brucellosis testing increased slightly to 180,000 in 1989.

The primary testing for pseudorabies is an ELISA test, read by a computer-driven automated system. Positive reactions are confirmed by a serum neutralization test run in tissue culture. A similar test for poultry diseases using the automated reader was used for 25,000 results during the year.

Livestock Health Programs

In 1901 the General Assembly authorized the trustees of Clemson College to employ a veterinarian for livestock disease investigation purposes. From this humble beginning grew concepts to control and eradicate those livestock diseases that pose potential public health problems and cause great economic losses to commodities.

A Swine Pseudorabies Monitoring Program and Swine Brucellosis Survey began Jan. 1, 1989. During the 1989-90 fiscal year, 408 swine herds were tested under this program.

Because of problems in other parts of the country, the department plans to identify and control salmonella contamination in livestock, poultry and meat and animal byproducts.

All livestock going through auction markets are inspected for evidence of contagious and infectious disease. Regulatory personnel attended 1,122 sales and inspected 314,886 animals. In addition to the various activities carried out by full-time employees, the division contracts with practicing veterinarians to attend each public sale of livestock to perform necessary tests, vaccinations and other tasks to ensure that all animals meet state and interstate requirements for sale and movement.
COLLEGE OF FOREST AND RECREATION RESOURCES

Founded in 1970, the College of Forest and Recreation Resources is responsible for promoting the wise management, use and stewardship of the natural resources of the state, region and nation. Under this mandate, the College of Forest and Recreation Resources continues to meet the needs of South Carolina through aggressive education, research and extension programs aimed at managing the state’s assets and enhancing the quality of life for South Carolina citizens through the wise use of leisure and the creation of pleasing living environments. The importance of this college’s function comes under sharp focus when it is noted that the college is the center of expertise for two major industrial groups in South Carolina. Together, the forest, recreation and tourism industries contribute in excess of $8.5 billion annually to the state’s economy.

It also should be noted that on March 8, 1988, the Department of Aquaculture, Fisheries and Wildlife became a third department in the college. It is jointly administered by the deans in the Division of Agriculture and Natural Resources at Clemson University. The annual report for the Department of Aquaculture, Fisheries and Wildlife will be listed under the teaching, research and Cooperative Extension Service sections of Agricultural Sciences.

All research and extension activities in forest management, wood utilization, and recreation resources and services are the responsibility of two departments — the Department of Forest Resources and the Department of Parks, Recreation and Tourism Management. Both departments offer educational programs from the baccalaureate to the doctorate degree. In addition, the Regional Resources Development Institute, created in 1981, operates under the auspices of the college and examines issues in natural resource allocation and community development throughout the state and region.

Department of Forest Resources

The Department of Forest Resources’ programs in education, research and extension are unique within the state of South Carolina. As such, the department plays an important role in educating many of the foresters who manage the 12.5 million acres of forest land in the state. This resource is responsible for more than $4 billion in annual sales of forest products produced by more than 1,000 wood-using industries.

As an integral part of Clemson University’s land-grant mission, the Department of Forest Resources’ goal is to provide to the citizens of South Carolina, the nation and the world:

- Educational programs at the undergraduate and graduate levels that (1) produce foresters and forest product specialists of the highest professional competence and integrity, and (2) expose non-majors to the understanding, wise use and management of the forest and its products.

- Forestry and forest products research programs that furnish the scientific expertise and leadership required for technical advancement and wise management and utilization of the forest resources.
• Direction and technical guidance by presenting existing knowledge and new research results in a useable form to forest landowners, the public, resource professionals, wood products firms and conservation-oriented organizations.

During the past academic year, 17 students received their Bachelor of Science degree, 13 in forest management and four in forest products. Five received their master’s degree and two received the Ph.D.

Over the past year, construction was completed to convert the basement of Lehotsky Hall to space for graduate student offices, a large auditorium for short courses and classes, wet labs, offices and storage. Although most of the renovated space houses the Department of Aquaculture, Fisheries and Wildlife, some of the space problems which have developed in the building over the past few years have been eased.

Another major development has been the planning and building of a new half-million-dollar Belle W. Baruch Forest Science Institute Laboratory near Georgetown, S.C. This lab, which was dedicated in November 1989, has allowed the scientists to move into modern facilities. Along with new personnel expected in the next few years, this combination of talent and facilities makes the institute one of the premier sites for coastal plain forestry research in the South. During the year, Dr. William Conner from Louisiana State University was hired as a wetlands ecologist, increasing Clemson’s expertise in this critical coastal plain issue.

At the end of the last fiscal year, Drs. Cool and McGregor retired. Dr. Cool, who has been teaching in the department since 1958, is well-remembered by all the students who have graduated from Clemson forestry over the decades. Likewise, Dr. McGregor, with a distinguished career as first dean of the college and then teacher and researcher, ended a fulfilling commitment to public service. Dr. Tom Straka from Mississippi State University was hired to teach forest management and management plans and to be the Clemson Experimental Forest administrator. Dr. Straka brings with him a wealth of teaching experience, taking over the already-in-progress forest management course as soon as he arrived.

With respect to the department’s undergraduate curricula, the faculty spent two days in January 1989 wrestling with some major curricula changes for both forest management and forest products majors. Another one-day retreat in May 1989 followed by months of faculty review by the Department Curriculum Committee brought about a new curriculum in forest resource management with three approved study areas — business, environment and science. A fourth area, public relations, recently has been approved by the faculty and is pending University approval. This new curriculum will become effective in August 1990. Along with the change in curriculum, the department hopes to attract a broader range of students, and to offer other courses to take better advantage of existing and future faculty expertise. Once the anticipated changes in the curricula are in place, the offerings in this department will be competitive with any similar natural resource program in the country.

With the change in curricula came the name change to the Department of Forest Resources, which denotes a broader context of educational endeavors. Likewise, the graduate degrees have been renamed to reflect this change.
The faculty in forest products also have reviewed their curriculum and soon will be proposing optional study areas. They have devised a long-range plan to increase student enrollment, increase faculty size and ultimately receive departmental status within the decade.

Faculty efforts in research during the year were underscored by numerous publications, most of which were the result of studies supported by state research and federal McIntire-Stennis funds, the two major sources of funding which give our faculty a great deal of freedom in identifying and solving problems concerning this state's valuable forest resources. Some areas of intensive, ongoing research are in geographic information systems, wood chemistry, biotechnology, nutrient cycling, silvicultural influences on watersheds, and habitat studies on deer, turkey and fox squirrel. Outside grants totaled more than $640,000 this past year, a credit to the department's growing reputation for quality research due to its excellent faculty and research facilities. During the year, Dr. Michael Taras, head of the department, has served as the 43rd president of the Forest Products Research Society, the international professional organization for forest products specialists.

With regard to research and public service programs, this past year has seen some challenges met. Much effort has gone into revising the long-range plan for the Clemson Experimental Forest, thanks to Dr. Allen and his faculty committee. This effort and final report have resulted in a Forest with long-term goals that cannot be sacrificed to the short-term plans that would compromise the worth of this valuable state resource. A brochure outlining plans for the forest has been published and sent to all interested user groups.

The acid rain/ozone research site on the Clemson Experimental Forest is now in its third and final year of data collection. Personnel to carry out this intensive effort are all in place, and major results soon are expected in concert with the other four sites in the South that also are studying commercial southern pine species. This effort, sponsored by the EPA and the Forest Service, should provide evidence concerning the effects of major air pollutants on tree growth. Also, in conjunction with the Forest Service's new Wetlands Research Unit in Charleston, the faculty at Hobcaw and Dr. Hook, who is housed at Charleston, will be cooperating in the development of proposals to address wetlands issues in the state.

Finally, the college has completed a major development with the acquisition of the Springfield Plantation, a 250-acre tropical forest and resort on Dominica. Over the next few years, the department will be making some major decisions concerning the development of a research program in tropical forestry. Because of this site, Clemson now has the opportunity to do research on this vital global issue.

Clemson has developed a reputation for sponsoring quality short courses for updating professionals who have been out of school for a number of years. For the tenth consecutive year, the forestry faculty taught a two-week continuing education course in advanced silviculture to U.S. Forest Service personnel from throughout the Eastern United States. For the sixth year, the department sponsored a Forest Service six-week short course on "Sale Area Layout and Harvesting." And for the first time, a three-week short course on "Managing Stand Structure and Composition" was offered to Forest Service wildlife professionals from throughout the nation. All three courses were coordinated by forestry extension specialists.
With regard to post-Hugo efforts to the state's forests, extension personnel provided information to homeowners and landowners on how to best salvage their shade trees and timber. Fact sheets were written, landowner meetings were conducted and numerous newspaper releases were generated to aid those most affected. Also, some of the department's faculty were, and still are, involved in statewide committees to provide guidance to the state's forestry sector, which witnessed the felling of three times the state's average annual harvest in a six-hour period.

Department of Parks, Recreation and Tourism Management

Teaching

Teaching personnel in the Department of Parks, Recreation and Tourism Management (PRTM) are dedicated to excellence in education at the bachelor's, master's and doctoral levels. Professional preparation by PRTM students leads to careers in public and private leisure-service agencies including county and municipal leisure services administration; youth serving agencies; federal, state and county recreation and park resource management; therapeutic recreation program delivery systems; and the broad field of travel and tourism management. Furthermore, preparation at the doctoral level is directed toward research and instruction in academic settings.

Fall 1989 enrollment for the department is shown below:

<table>
<thead>
<tr>
<th>Undergraduate</th>
<th>335 students</th>
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<tbody>
<tr>
<td>Travel and Tourism</td>
<td>41%</td>
</tr>
<tr>
<td>Therapeutic Recreation</td>
<td>15%</td>
</tr>
<tr>
<td>Resource Management</td>
<td>10%</td>
</tr>
<tr>
<td>Community Leisure Services</td>
<td>8%</td>
</tr>
<tr>
<td>Undecided/Transfers</td>
<td>26%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Graduate</th>
<th>40 students</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPRTM</td>
<td>28%</td>
</tr>
<tr>
<td>M.S.</td>
<td>28%</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>44%</td>
</tr>
</tbody>
</table>

Highlights within PRTM's instructional program for the 1989-90 year included:

- The Ph.D. program saw its first four students graduate. These individuals were Sung-Soo Pyo and Pat McGuir, who were directed by Dr. Muzaffer Uysal; Elizabeth Adams, directed by Dr. Wes Burnett; and Kathy Anderek, directed by Dr. Robert Becker. Ph.D. enrollment continues to remain above the estimate projected when the program was originally proposed.
- Three incoming Ph.D. students have been awarded fellowships as a result of University-wide competition, reflecting the continuing high quality of students in the graduate program.
• Course refinements and new course development have been pursued to reflect adjustments in the respective undergraduate fields and the overall increase in the number of graduate students.

• Adjustments in course offerings by other departments continue to be taken into account when advising students in their programs of study.

• Four new faculty will be on board in the fall of 1990 to ease the continued student demand for the travel and tourism emphasis area and to fill recently vacated positions.

• PRTM successfully underwent academic and accreditation reviews by the Commission on Higher Education and the National Recreation and Park Association, respectively.

Public Service/Research

Research dollars have been allocated to projects that can be applied to local problems in South Carolina. This is especially true for developing guides for marketing plans in South Carolina tourist regions. Faculty continue to actively pursue research that will bring national visibility to Clemson and South Carolina. Data from numerous recreation surveys were obtained for Clemson analysis, which could lead to Clemson’s recognition as a national recreation data depository and analysis center. Cooperative research agreements have been arranged with the Corps of Engineers and with the University of West Indies. These endeavors promise to expand the research thrust within the department.

Faculty made 20 research presentations at national and regional meetings and more than 60 other professional presentations to a variety of audiences. Graduate student presentations were encouraged, and presentations by these students representing Clemson were productive. Faculty and graduate students generated 70 publications, with over one-third (25) appearing in national refereed journals. Faculty are continuously requested to serve as referees of research publications and serve on editorial boards of professional journals. In addition, 12 grants were received by PRTM, generating more than $132,000 in new research activity.

Public Service/Extension

The department’s commitment to education extends beyond involvement with undergraduate and graduate students to include a continuing successful program, College Week for Senior Citizens. During 1989-90, this program served just under 300 citizens from South Carolina and the surrounding region and generated in excess of $48,000 in gross income. Tourism-related extension activities in 1989-90, which had been assigned under the administration of the Recreation, Travel and Tourism Institute (RTTI), were less evident due to a faculty vacancy in the director’s position. Numerous professional presentations were delivered to organizations at the state, regional and national levels. Faculty served on professional boards, editorial boards of national journals and held offices in professional associations.
Outdoor Laboratory

In 1989-90 requests for space at the Clemson University Outdoor Laboratory reached a level that will be difficult to exceed in future years. The pattern of significant annual growth in user days peaked this past year, with 92.4 percent of the available days occupied by groups.

The Outdoor Laboratory was open 356 days in 1989-90. On 329 of these days, at least one group used a part of the facility. The total number of groups served was 222, compared to 194 groups the previous year. This represented a growth of 14.4 percent.

Growth in individual use within the groups also increased. In 1988-89, excluding the seven residential summer camps, 11,855 people used the facilities. During this past year, 12,930 participants were counted, giving a one year growth of 9 percent, or 1,075 individual users.

The summer camps were near capacity in 1989, with an occupancy rate of 98 percent of capacity. More than 800 campers participated in the seven residential programs held between mid-June and mid-August. The summer staff represented majors from five disciplines at Clemson University, with the majority coming from PRTM. More than 50 students from colleges and universities across the country worked in the program component of the summer camps. The summer camps were fully funded by various support clubs and camper fees.

The South Carolina Jaycees raised $52,000 for Jaycee Camp Hope and Rainbow for Hope. This organization gave $30,000 to the summer operation, and the balance was given as part of a $25,000 annual pledge to the Rainbow for Hope endowment.

The Sertoma Clubs of South Carolina raised nearly $45,000 to send 240 children to Camp Sertoma. They continued work toward establishing an endowment for Camp Sertoma. The state organization approved this fund-raising effort in the spring of 1989.

The Mid-Day Lions of Anderson sponsored Camp Lions Den for the eleventh consecutive year. Forty campers with visual impairments attended. This club also gave $1,000 to Rainbow for Hope. Camp Running Brave (for hemophiliacs), Camp Paupi-Win (for adjudicated youth) and the Muscular Dystrophy Camp also were conducted at the Outdoor Laboratory during the 1989 summer season, serving an additional 160 special campers.

The staff of the Outdoor Laboratory can provide four types of support to user groups: program support, food service, maintenance and business office services. The staff takes full responsibility for managing three one-week sessions for senior adults in Senior Adventure Camp, the operation of three environmental education camps for area schools, coordinating Camp Placement Day for the University, and the year-round operation of the Outdoor Adventure Course.

In 1989-90 a record number of Clemson University students (468) were utilized in programming, maintenance and food service. Of this group, 348 came from PRTM. The professional staff at the Outdoor Laboratory is committed to providing unlimited opportunities for continued education and training to University students.

The endowment for the Outdoor Laboratory, Rainbow for Hope, concluded Phase II of fund-raising in February. On February 3 the South Carolina Knights of Columbus presented to our Honorary Chairman, Lt. Governor Nick Theodore, a check for $100,000.
The next Saturday in Columbia, the South Carolina Jaycees presented to Dr. Max Lennon a check for $150,000. The combined income currently invested approaches $400,000.

A five-year budget and planning program was completed during the past year and presented to the PRTM administration. With many of the facilities at the Outdoor Laboratory being more than 15 years old, the adoption of this plan and budget would enable the professional staff to keep buildings, roads, trails and equipment in acceptable condition. A commitment to this proposal would require annual funding beyond previous budget requests.

The Clemson University Outdoor Laboratory continues to be a busy place. The effort expended by all staff to serve the numbers of groups, individuals and summer camps exceeds what is normally expected by the University. The staff often puts service to others ahead of personal needs. The quality and dedication of the current staff is the major reason for such a successful year.

**Professional Development Program**

Programs and short courses were developed and delivered to the U.S. Forest Service Data General Computer Training Program, National Recreation and Park Association, youth computer training program, U.S. Forest Service Recreation Management Division, Army Corps of Engineers, National Park Service and senior citizens. These programs served approximately 800 clients, grossed $185,800 and were staffed by existing faculty, support staff, graduate assistants and occasional outside speakers.

**Regional Resources Development Institute**

Established in 1981, the Regional Resources Development Institute (RRDI) is a component of the College of Forest and Recreation Resources at Clemson University. RRDI directs its resources toward South Carolina and the surrounding region in a cooperative and interdisciplinary manner. By conducting research on issues relating to people, communities, regional development and natural resources, the institute’s expertise is creatively channeled.

Currently the institute is involved with resource policy development/assessment, resource allocation and management, rural development, tourism and regional development, small town revitalization, conservation/policy issues and conflict resolution issues.

Since RRDI is primarily a research institute, opportunities for student and faculty participation are important components. Several graduate students are supported, and various projects encompass interdisciplinary involvement.

RRDI’s 1989-90 projects, briefly outlined below, fall under three major umbrellas: the SC—Today & Tomorrow Program, the John De la Howe/Clemson University Initiatives and the Geographic Information Systems/Natural Resources Program.

The SC—Today & Tomorrow Program activities included:

- Finished a content analysis study for S.C. Sea Grant Consortium pertaining to coastal issues in newspapers.
- Began a project with S.C. Sea Grant and National Coastal Research Institute to study and help develop nature-based tourism businesses in rural coastal areas.
• Began a small town revitalization program with Summerton, S.C., and the S.C. Downtown Development Association.
• Secured funding for S.C. in-migrant retiree housing study.
• Secured funding from S.C. Visions for Youth to compile an annotated bibliography of programs relating to youth and rural sociology.
• Initiated work with the S.C. Crafts Association to develop a questionnaire to catalog all craft persons in the state.
• Initiated a study of the Heritage Festival in McCormick, S.C., for the McCormick Arts Council.

The John De la Howe (JDLH) School cooperative initiatives included:
• Architecture graduate students finished a booklet on design plans for dairy barn. RRDI began work with JDLH staff and Drakeford architects to bring country market plans on-line.
• Completed work with a new group of College of Architecture graduate students to develop an architectural master plan for the JDLH campus.
• Sponsored a therapeutic recreation workshop for JDLH staff and an educational seminar on JDLH for Clemson University faculty and staff.
• Produced a videotape explaining the cooperative initiatives currently under way between Clemson and JDLH.
• Began the process of providing graduate courses to JDLH staff through Clemson University’s Telecampus Program.
• Worked to develop educational and entrepreneurial programs to assist JDLH with the eventual operation of their country market.

The Geographic Information System (GIS) Program initiatives included:
• Developed the college GIS Research Facility with state-of-the-art hardware and software. Participants include RRDI, PRTM, Forestry and the U.S. Forest Service.
• Completed a pilot project with Dr. Clare Gunn (Texas A&M) to test his tourism planning model as it applied to six upstate counties in South Carolina.
• Received a grant from the Southeast Climate Center to complete a regional data matrix and atlas.

Other activities within RRDI included the addition of three research associates to the support staff as well as several graduate assistants, and the inception of RRDI News, the institute newsletter.

Computer Laboratories

The sixth full year of operation for the college’s IBM-PC Laboratory was successful. As well as instruction for undergraduate and graduate students in the college, personnel from the National Park Service, USDA Forest Service, Office of Professional Development in the College of Commerce and Industry, Continuing Engineering Education and the National Recreation and Park Association used the laboratory for computer skill enhancement. Actual use of the IBM lab during the past year exceeded 15,000 participant hours.
Courses within the college have been adapted to provide students with computer application skills pertaining to the management of today’s varied and extensive leisure and forestry industries. Numerous courses within the college currently offer instruction in computer applications for both undergraduate and graduate students.

Upgrading of the printers in the IBM-PC Laboratory was carried out this year to provide better quality output for all users. A full complement of up-to-date software is now available, including word processing, spreadsheets, databases, statistics, graphics, grammar, forestry programs and telecommunications. To enhance the ability of the students to do statistical analyses in the lab, the IBM computers are also outfitted with math coprocessors. The lab also installed several 3 1/2 inch disk drives.

The Data General (DG) Computer Training Center was established as a cooperative effort between the college and USDA Forest Service and is the only one of its kind in the nation. The center has hosted training programs for Forest Service personnel as well as college faculty and students. The center also supports existing cooperative research and training programs.

Also, this marks the first year of operation for the Geographic Information System Research Facility/Laboratory. As mentioned earlier, several exciting projects are underway in the GIS Lab. Overall, the College of Forest and Recreation Resources is committed to a leadership role in both the leisure services and forestry fields. The utilization and continual improvement of the IBM-PC and DG Computer Laboratories and the GIS Research Facility are important means to maintaining this leadership role.

ACADEMIC AFFAIRS

Clemson University Libraries

Introduction

Increased productivity of the staff keynotes the 1989-90 fiscal year for the Clemson University Libraries. New services were implemented, existing services were enhanced and collections were increased by a staff that remained stable in numbers.

Services

Many new services were initiated during the year, ranging from off-desk telephone reference services to workshops for Selective Depository Libraries in South Carolina. Almost all library units were responsible for beginning new services to users.

In the reference area, several new services have been created to improve assistance to library patrons. The hours the Reference Desk is manned have increased to accommodate faculty and graduate students who do research during semester breaks and other periods when classes are not in session. One service heavily used by graduate students is Do-It-Yourself Searching. This service is only available during the evening hours and on weekends from the database vendors. To provide Clemson graduate students access to these databases, the Reference Unit remains open two evenings a week and on
weekends during breaks. With 1,834 searches on Do-It-Yourself Searching, the maximum has been nearly reached. The two most frequent databases accessed via DIY are Compendex and Biosis.

Cooper Library is now open 356 days per year, including all weekends except for the Christmas weekend. To assist users who do not physically come to the library, a telephone reference service has been started and is manned by staff who are away from the desk during the four busiest hours each day.

Several reference librarians have created newsletters directed to the colleges and departments they serve. These newsletters inform faculty about new services and are a vehicle for collection development. Two new faculty copiers were purchased and placed in service this year. The cost per copy is five cents, and these copiers are used with accounts set up by the various colleges and departments. The interlibrary loan operation increased dramatically this year. Both loans and borrows were up considerably; loans by nearly 10 percent and borrows by more than 20 percent.

Several new services have been initiated by the Circulation Unit. A new Reserve and Media Room has been created from the space previously occupied by the Special Collections Unit. The reserve function has been combined with microforms and other media formats. Video and audio recordings will be added during 1990-91.

Reserve and Media staff also are providing document delivery service to faculty and staff. This new service, now combined with EDDIE (E-mail Document Delivery & Information Exchange), provides faculty and staff with the ability to send preformatted e-mail requests for material to be checked out and delivered to their office. From EDDIE a patron may do a variety of things: check out material, request a photocopy of a journal article, request an interlibrary loan, request a book or journal be purchased, ask a reference question or send a suggestion to the library. Depending upon which service is utilized, the e-mail message is directed automatically to the appropriate unit within the library.

The addition of the two ERIC databases provided access via DORIS to educational materials. Also during the year, several of the IAC databases were reloaded to correct some errors. The introduction of EDDIE and continuing improvement of DORIS represent the continuation of the implementation of the "library without walls" philosophy. Three new book returns were acquired and installed during the year. For the first time, library users may return their books to sites located away from the libraries. Book returns now are located in the University Union lobby and the lobby of Byrnes Hall on East Campus.

The Cataloging Unit implemented on-line authority control to NOTIS this year. For the user, this activity will pay off when the next version of the NOTIS software is installed late in 1990-91 by providing cross references in the LUIS database. This will complete the addition of cross references to LUIS. It should be noted that NOTIS was down only three hours during work hours for the entire year.

The Special Collections Unit spent the year getting settled into its new facility in the Strom Thurmond Institute Building. While the settling in period has not been without its problems, for the most part it has been successful. There was some loss of patrons due to the new location, but that should be recovered as users begin to identify Special Collections with the Strom Thurmond Institute Building. To help with that process, an archives brochure was published this year.
New services in micrographics and exhibits also were initiated during 1989-90. A micrographics coordinator and a director of exhibits were selected and are at work. One new program being provided by the director of exhibits is the review of "rare possessions," including a program to review material being placed on the surplus list to ensure that a rare item is not lost. A major advance in the area of automation for Special Collections was the inputting of 1,732 descriptions of Senator Thurmond's speeches into the NOTIS system. These will form the basis of a new "institution" within NOTIS that will describe manuscript records.

A similar effort is rapidly taking shape in the Gunnin Architectural Library, where descriptions of each of the more than 76,000 slides are being input into the NOTIS system. Again these records will form the basis of yet a third "institution" and provide access to the valuable slide collection. A major step in this project is the creation of a new call number system for the slides, and this aspect of the program is nearly complete.

As a Shared Regional Depository for U.S. documents, the Clemson Libraries have several responsibilities to the "selective" depositories located within the state. During this year, the year of inspections by the Government Printing Office, Clemson's documents librarian visited four of the selectives with the GPO inspector. Further, she published two newsletters for the librarians at the selective libraries, covering general issues as well as reports on the meetings of the Depository Library Council. She also held a workshop for librarians of seven of the selectives in the state.

A major accomplishment for the year was the result of GPO's inspection of Clemson's collection. Of the eight categories for which ratings are given, Clemson received six "excellents" (the highest rating) and two "goods" (next highest rating). The next inspection is scheduled for 1993, the centennial of Clemson being a government depository. The library expects to have eight "excellent" ratings for that celebration. On the state level, the retrospective records of the state documents were added to the NOTIS database.

Collections

During the year the staff added 25,590 books and bound journal volumes, 63 archival collections, 102 videotapes and 1,148 Clemson theses to exceed 700,000 cataloged items in the collection. The library anticipates reaching three-quarters of a million cataloged items within the next two years. In addition, 219 new journal subscriptions were added. The balance for the year between expenditures for journal subscriptions and book purchases was 75 percent subscriptions and 25 percent books. The percentages should continue to increase for subscriptions since the forecast calls for a 20 percent increase for 1990-91, making it difficult to add new subscriptions.

The initiation of a book approval plan during the year was helpful in acquiring the latest books in many disciplines. During the year, approximately $95,000 was spent on books identified by this plan. A total of more than $485,000 was spent on the acquisition of books. The average cost of a book for the year was $45. To provide access to documentation of Hurricane Hugo, the library acquired the microfilm edition of the Myrtle Beach Sun News.

A good deal of manuscript and archival material was added to those collections during the year. Two major collections were officially donated, the papers of Earl
Morris Jr., state comptroller, and Nancy Steorts. A smaller collection of papers of J. Fred Buzhardt Jr. also was received. The Records Center had a major increase in the number of cubic feet of records accessioned for the year.

In addition to increasing the size of the collection, the library made concerted efforts to help preserve existing materials. A preservation/mending unit was established to extend the life of materials. Further, the Libraries' Classified Staff Council led an anti-vandalism campaign covering library materials and facilities. The binding contract was bid during the year, and a new binder is providing an automated binding system, which greatly assists the staff in the preparation of materials for binding.

Because of the decision late in 1989 to close the Sirrine Library in the College of Commerce and Industry, a good part of 1989-90 was spent shifting the collections in Cooper Library to accommodate the materials transferred from the Sirrine Library. This relocation impacted nearly every area of the Clemson University Libraries, particularly the cataloging, circulation and reference areas.

Facilities

As indicated above, this was the first full year for the Special Collections Unit in its new facility in the Strom Thurmond Institute Building. While it has generally been a positive move, living experience has brought to light several shortcomings of the facility. The item of primary concern is the need for mobile shelving. When the space was designed for the stacks of rare books, archival materials and manuscripts, it was anticipated that mobile shelving would be used. However, when the shelving was purchased, construction funds were not available for mobile shelves, and fixed shelving was purchased. This has resulted in the stack space being nearly full after only one year of occupancy. Efforts have been initiated during the year to attract sufficient private funds to permit the installation of mobile shelving.

Late in the year the Gunnin Architectural Library began a "face-lift" with new furniture and new carpet. The process will be completed in the early part of 1990-91. Other additions included new terminals and a new controller to provide multiple session capability, allowing users to easily move from LUIS to DORIS and to increase the availability of DORIS to patrons using the Architectural Library.

Similar changes were made to the terminals in Cooper Library. New ones were acquired to replace some older terminals, and new controllers were purchased to allow all public use terminals to access LUIS and DORIS.

Library Usage

Once again the number of people using the Clemson University Libraries increased. There was more than a 6 percent increase in the number of people visiting the libraries. The reference staff sustained a 17 percent increase in the number of inquiries. As noted earlier, the interlibrary loan service dramatically increased, up a total of 15 percent. The heaviest increase in interlibrary loan is in the amount borrowed for patrons. This trend should continue due to a philosophical change taking place in the concept of providing information to users. Access to information is increasingly becoming more important, while housing material is becoming increasingly less important. With this change, the library expects to see major changes in acquiring information for resources beyond Clemson's collections.
Fund Raising

During the year, the Clemson University Libraries and Development Office created the second Library Friends mailer. From early returns, it appears that the second mailer will be more successful than the first, which raised nearly $20,000 for library materials and projects. Joseph Shirley completed his commitment to provide $1 million to the Callie Jones Shirley Library Endowment. This endowment is now beginning to provide interest, which will make a difference each year in the acquisition of materials. Again, this year, a new Presidents Club member designated the libraries for his gifts. Two gifts of $100,000 were pledged during the year for the libraries. One, given by Frank M. Bishop Jr., is a five-year planned gift of $20,000 per year. The other, by Captain Wilbur N. Ginn Jr. and Wilbur N. Ginn III, is a bequest.

During the year, the Professional Development Office of the College of Commerce and Industry became the fourth Library Founding Patron of Excellence, marking total giving to the libraries in excess of $50,000. Faculty from the departments of Architectural Studies and Planning Studies donated their professional development money ($50 per faculty member) for Gunnin Architectural Library acquisitions. These funds were matched by the College of Architecture Foundation for a total of $3,000. These were in turn matched by the Clemson University Libraries, providing a total of $6,000 for the purchase of architectural materials.

Staff

The successes documented in part in this report come as a direct result of the competency and dedication of a staff of some 85 women and men in the Clemson University Libraries. The University can be justifiably proud of its library staff. A number of staff changes took place during the year. Deborah Johnson came as head of the Gunnin Architectural Library, allowing Martha Lyle to return to Cooper Library as engineering librarian and coordinator of on-line services. Two new faculty were appointed to work in the Bibliographic Instruction area of the Reference Unit: Priscilla Wentworth and Lorraine Evans. Susan Hiott was appointed director of exhibits, and Ron Williford moved from the Sirrine Branch to help establish the document delivery program and then to his current position of micrographics coordinator. Unfortunately, there were some to leave during the year, notably two retirees: Marian Withington, who retired after 26 full-time years in the Clemson library, and Bernice Holt, who retired after nearly 40 years of part-time service to the libraries.

The Classified Staff Employee of the Year for 1989 is Rick Brink. Rick is the electronics technician for the libraries. The 1988 winner, Ruth Taylor, received yet another honor, election to the chair of the Commission on Classified Staff Affairs for 1990-91.

Once again the Libraries Classified Staff Council led its members and committees to provide an outstanding service in representing the members of the classified staff. The council sponsored several staff development activities within the libraries, including seminars on rape prevention, business writing techniques and assertiveness training.
### Library Statistics - 1989-1990

#### COLLECTIONS

<table>
<thead>
<tr>
<th>Books/Journals</th>
<th>Accessioned</th>
<th>Withdrawn</th>
<th>Net Added</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataloged</td>
<td>25,590</td>
<td>4,637</td>
<td>20,953</td>
<td>707,274</td>
</tr>
<tr>
<td>Uncataloged</td>
<td></td>
<td></td>
<td></td>
<td>2,519</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25,590</td>
<td>4,637</td>
<td>20,953</td>
<td>709,793</td>
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</table>

| Documents and Reports | 679,454 |

<table>
<thead>
<tr>
<th>Microforms</th>
<th>Microfilm</th>
<th>Microfiche</th>
<th>Microcard</th>
<th>Vol. Equiv.*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Docs</td>
<td>1,523</td>
<td>871,194</td>
<td>0</td>
<td>88,642</td>
</tr>
<tr>
<td>Other</td>
<td>22,057</td>
<td>556,679</td>
<td>31,499</td>
<td>80,875</td>
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<tr>
<td><strong>Totals</strong></td>
<td>23,580</td>
<td>1,427,873</td>
<td>31,499</td>
<td>169,517</td>
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</table>

**GRAND TOTAL - PRINTED MATERIALS** 1,558,764

* Microform volume equivalents are determined by counting microfilm reels as one volume and ten microfiche or microcards as one volume.

| Slides | 76,611 |
| Maps   | 17,921 |
| Videotapes | 215 |

**Current Subscriptions**

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<tr>
<th>1988-89</th>
<th>1989-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Periodicals</td>
<td>5,885</td>
</tr>
<tr>
<td>Other Serials</td>
<td>1,071</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>6,956</strong></td>
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#### CIRCULATION

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<thead>
<tr>
<th>Door Count of Users</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Cooper</td>
<td>792,760</td>
</tr>
<tr>
<td>Gunnin</td>
<td>74,394</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>867,154</strong></td>
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</table>

<table>
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<tr>
<th>Books Circulated</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Cooper</td>
<td>224,744</td>
</tr>
<tr>
<td>Gunnin</td>
<td>34,424</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>259,168</strong></td>
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#### REFERENCE SERVICES

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<thead>
<tr>
<th>Inquiries</th>
<th>1989-90</th>
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<tbody>
<tr>
<td>Directional</td>
<td>4,963</td>
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<tr>
<td>Reference</td>
<td>48,415</td>
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<tr>
<td>Research</td>
<td>898</td>
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<tr>
<td>Telephone</td>
<td>n/a</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>54,276</strong></td>
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Computer Connects for Searches

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<tr>
<th>Service</th>
<th>Quick</th>
<th>Do-It-Yourself</th>
<th>Reference</th>
<th>Research</th>
<th>DORIS</th>
<th>Totals</th>
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<tr>
<td></td>
<td>3</td>
<td>1,803</td>
<td>117</td>
<td>151</td>
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<td></td>
<td>6</td>
<td>1,834</td>
<td>210</td>
<td>128</td>
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Interlibrary Loans

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<tr>
<th>Service</th>
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<th>Borrowed</th>
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<td></td>
<td>6,498</td>
<td>6,700</td>
<td>13,198</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>7,112</td>
<td>8,049</td>
<td>15,161</td>
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</table>

Computing and Information Technology

Computer Center

Despite budgetary uncertainties due to the unpredictability of the Computer Center’s outside business, the center continued to meet the computing demands of both University and non-University customers in 1989-90. An over-reliance on outside revenue to fund computing operations remains a potentially serious problem, however, as noted in previous reports.

The University’s mainframe computer was replaced in May 1990 with a machine of approximately twice the power. Assuming the present rate of usage growth to continue, the new machine can be expected to last for two to three years. Usage growth on the mainframe is now almost exclusively due to the expansion and use of information databases rather than for instructional computing. Installation and expansion of such systems as the the library’s LUIS, the on-line text retrieval system DORIS, the new on-line housing system and the Student Information System, among many others, have contributed to a spiralling increase in the number of transactions processed by the mainframe, an increase not expected to slow down.

Computer Center funding has not kept pace with the growth in utilization. In 1990-91, therefore, the center will begin to bill University departments for some of the increased costs of computing operations. Initially an attempt will be made to recover from administrative departments the incremental costs associated with providing increased disk storage space for their information databases.

Academic computing continues to show rapid growth on the VAX computing network. This network is also becoming the base of the University’s office automation systems. Information technology is steadily helping to improve the efficiency of administrative offices as they move from simple word processing to document and file transfer, and network access to all of the University’s information databases. The installation of encryption devices on the VAX network has significantly increased its security and made it much more attractive for sensitive administrative applications.
The Micro Center has been expanded, both in space and personnel, in response to the demand for microcomputer sales and consulting support from students, faculty and staff. Despite the increase in the number of students with their own microcomputers, the demands placed on the Computer Center’s microcomputer laboratories continue to grow. The Computer Center has conducted a study of the usage patterns of its microcomputer laboratories and discovered that reservation of those facilities for class sessions is severely eroding their availability for public access. The center is formulating a strategy for ensuring that machines are available to students when they need them and are not always tied up by classes.

Significant changes in the computer software industry have necessitated a re-evaluation of the University’s long-term plan for software systems development. This re-evaluation is still taking place. Whatever the results, one thing is clear: There will be a large increase in software expenditures by the University in the coming years.

Computer Center revenue remained stable in 1989-90 despite a mid-year rate reduction. A new charging model has been developed to satisfy federal auditing requirements. Strict adherence to this model will severely reduce any flexibility the center had in setting rates, making revenue even more difficult to predict than it has been in the past. The University will not be able to adjust rates to bring in a pre-determined amount of revenue.

Despite all the questions relating to long-term funding, service levels to computer users have consistently remained high. The center is holding firm to its commitment that Clemson’s computing services will remain second to none.

Information Systems Development

The 1989-90 year was yet another successful one for Information Systems Development (ISD). The division continued to be entirely self-supporting despite funding cutbacks at several of its major customers. While there were no major new contracts signed during the year, the contracts already in force were sufficient to fully occupy and fund the staff.

Systems development services to state agencies continue to provide the bulk of ISD’s business. Major contracts are in force with the Health and Human Services Finance Commission and the departments of Social Services, Corrections, and Health and Environmental Control. To reduce ISD’s dependence upon South Carolina’s state agencies, bids have been submitted to develop various computing systems in other states. Competition is fierce for such contracts; however, and to date none have been secured, though ISD’s bids have been competitive.

ISD’s research and development activities continue to show progress. A subcontract from the Clemson University Research Foundation to develop marketable software is expected to yield revenues to support further R&D endeavors. ISD provides support for a number of faculty members on release time to work on contracts with commercial companies.

ISD’s growth depends on its ability to attract contracts from organizations other than South Carolina state agencies. The availability of funding for those South Carolina agencies is not likely to increase significantly in the foreseeable future. Success in attracting contracts from outside the state has been limited to this point, largely because
of the ferocious competition in the systems software development business. While not yet successful in landing a major out-of-state contract, ISD has recently been the runner up in two large publicly bid systems development solicitations, so the division’s hopes for success remain high.

ISD is attempting to gradually shift the emphasis of its activities to be more supportive of the University’s new concentration on specific areas of research. While this will not occur overnight, the change from a database systems development group to a research support group is necessary and inevitable. ISD’s long record of success gives rise to a high degree of confidence that such a major realignment can ultimately be achieved.

Administrative Programming Services

Administrative Programming Services (APS) develops and supports information systems for Clemson University. In 1990, APS completed its fifteenth year as the group responsible for building University databases and software systems to use them. APS works with the University vice presidents and their designees to plan and implement a wide range of information systems.

While new services are being provided in all areas, the most dramatic growth has been in information systems that support the mission of the Cooper Library. The on-line catalog, LUIS, is the mainstay of these services, while the text searching and retrieval system DORIS continues to provide new databases. For example, any student or faculty member can search the contents of five major U.S. newspapers over the past five years to obtain information on any subject of interest. Almost all other universities require that such searches be performed in the library using a remote database under the direction of a librarian. Clemson provides such services on the computing network to all students enrolled as well as all faculty and staff.

Dramatic growth also is taking place in the area of student services. The degree audit and student advising systems were expanded to cover the majority of students enrolled. These systems are currently being enhanced to provide this information on-line, much as the Student Information System provides services such as preregistration, career placement interview signup and academic record retrieval. During the past spring semester, the new student housing system allowed all students to request housing assignments from terminals on the computing network. Incoming freshmen use the preregistration system during summer orientation to plan their fall class schedules.

Business systems are being expanded to provide electronic transfer of forms over the campus and throughout the state. The new purchasing system allows departments to initiate purchase requisitions from terminals on the computing network and route these documents electronically through administrative channels. Upon administrative approval, these documents are released electronically to the purchasing system. Other business systems are continually being enhanced to provide new services and to adapt to new technical developments such as the on-line system development tool, ADS/OL, which is now being used to develop systems more quickly and efficiently.

APS also assisted Institutional Advancement in the conceptual design of new systems to support the alumni affairs and development efforts. A new database and software
system is being implemented to support this vital area. Significant improvements have been made in the mailing and postal incentives area as well.

APS has benefited greatly from the services provided by the Computer Center, services which are improved significantly by virtue of the outside contracts held by the Computer Center. To date, growth in University systems has never been impeded for lack of computing resources. As the Computer Center begins to provide an increasing amount of University support, the funding of the growth of University systems will need to be addressed more directly than in the past.

As the software industry continues to experience dramatic changes, APS will devote more attention to evaluating how best to provide information systems to the University. While the University has a wide portfolio of systems that are continually enhanced, it is clear that major investments will need to be made to ensure that information systems continue to effectively support the University.

The Graduate School

One new graduate program, the M.S. degree in geology, was approved by the Commission on Higher Education. Six degree program proposals were approved by the University Graduate Curriculum Committee and have been forwarded to the commission for final approval.

Completed applications for admission in the 1989 fall semester increased by 21 percent to a record 3,742. As in the previous year, the increase in domestic applicants resided primarily in the areas of business, social science and education. The majority of international applicants continued to seek admission in science or engineering. Overall, approximately 48 percent of the pool of applicants was accepted, resulting in 1,022 new enrollees. A record of 3,607 enrollees included 1,488 full-time students, 1,789 females and 1,818 males.

Graduate degrees awarded in the period August 1989-May 1990 totaled 749; 667 master’s, 72 doctorate and 10 specialists.

By most accounts, the modest programs to improve the effectiveness of graduate instructional assistants were successful. Programs aimed at improving professionalism proved beneficial to undergraduates, as well as graduate assistants. The decentralized approach, with efforts emanating from the respective colleges, will be continued indefinitely as long as the results are positive.

The National Dropout Prevention Center

The National Dropout Prevention Center, founded in 1986, has completed its fourth and perhaps most significant year. Considerable progress has been made during the past year in focusing the center’s mission and program.

In its formal mission statement, the center reaffirms its commitment to “significantly reduce America’s dropout rate by fostering public-private partnerships in local school districts and communities throughout the nation.” That statement further defines the work of the center by stating that the “Center cultivates these partnerships by collecting, analyzing and disseminating information about dropout prevention policies and practices; and, by providing technical assistance to develop and demonstrate dropout prevention programs.”
The center is organized under the Office of the Provost. Additionally, for most of its existence, the center has been affiliated with the National Dropout Prevention Fund, a not-for-profit organization of business and industry leaders. That fund is now being dissolved, and the center plans to restructure its partnership with a national Council of Advisors, a South Carolina Committee and a National Dropout Prevention Network Committee, and plans to establish The National Endowment for Dropout Prevention.

The Focus Database

The National Dropout Prevention Center is dedicated to providing the most usable and accurate information possible on school dropout prevention to its clients. One primary vehicle used to accomplish that is the database FOCUS, which consists of several subsets of information accessible from 7:00 a.m. until 1:00 a.m. (EST), seven days a week from anywhere in the world.

The largest subset consists of abstracts of successful school dropout prevention programs from across the country. Programs may be selected by using any number of descriptors. For example, clients can search for programs concentrating on middle schools in a rural setting with a teen pregnancy component, or for business-education or community partnership programs.

FOCUS also contains a national calendar of conferences and workshops on at-risk issues. The center maintains a reference library containing books, journal articles, research reports and legislation that deal with the dropout crisis. These are abstracted in the FOCUS database.

Workshops and Presentations

The National Dropout Prevention Center engages in a number of outreach activities, including presentations at conferences and workshops for a variety of audiences. During the past fiscal year, center staff made 83 presentations in 11 states to more than 5,000 participants. These included major conferences such as the annual conference of the Mentoring Association, the National Youth At Risk Summit and the National Dropout Prevention Conference, as well as state and local conferences like the S.C. Bar Law Related Education Day, the Francis Marion Conference on At-Risk Youth, the Conference on Alternative Education and meetings of chambers of commerce.

Additionally, the center conducts staff development workshops for teachers, school counselors and administrators on effective strategies for dropout prevention, how to identify at-risk youth, building self-esteem and effective grant writing.

Technical Assistance

Often the center receives calls from schools, districts, communities and organizations who are either initiating dropout prevention programs or writing proposals to secure funding for such programs. The center provides these groups with guidance and assistance. For example, the South Carolina Department of Education recently awarded grants to schools and districts in the state as a result of education improvement legislation passed by the General Assembly. The center provided help to more than 30 of those schools and districts in preparing grant proposals. The center also provided
technical assistance to 30 school districts that had been awarded grants from the Pennsylvania Department of Education to develop model dropout prevention programs.

The center has become a credible and reliable source of information for the media. During the last year, the center was contacted 110 times by media representatives requesting assistance on feature stories and/or news reports about the dropout crisis. The center was cited as a primary source in more than half of those stories. National media accounted for 15 percent of those inquiries. Center experts appeared on NBC, CBS, ABC and CNN, and were quoted in numerous national publications such as USA Today, US News and World Report, the New York Times, Education Week and in Thinking Magazine (a Japanese publication). Staff appeared on more than 15 radio talk shows, including a statewide show hosted by Governor Richard Celeste of Ohio.

Center staff provided technical assistance to numerous education and budget committees and sub-committees of state legislatures from South Carolina to Washington state in drafting legislation affecting at-risk youth. Anticipating rising interest in at-risk legislation, the center conducted a unique national survey of legislative initiatives and published recommended strategies relative to the restricted driver’s license for school dropouts for legislative bodies to follow in seeking to meet the needs of at-risk youth.

The center filled a number of advisory functions during the 1989-90 year for clients such as the American Bar Association, Young & Rubicam, Burson Marsteller Army Group, National Association for Industry-Education Cooperation and the Kellogg Foundation-funded Visions for Youth project.

The 1989-1990 Partnership Campaign

The National Dropout Prevention Center is a public-private partnership dedicated to nurturing partnerships to meet the needs of at-risk students. To that end, the center initiated an annual “partnership” campaign in South Carolina during the last operational year. During that campaign, the center enlisted the support and assistance of 26 partners including: The Governor’s Office, the S.C. Department of Education, the S.C. Chamber of Commerce, Carowinds, the Palmetto Project, S.C. Educational Television, the S.C. Press Association, the S.C. Merchant’s Association, the S.C. Broadcaster’s Association, Pizza Huts of S.C., NCNB National Bank of South Carolina, Adidas USA, the Duke Power Company Foundation, Carolina Power & Light, SCANA Corporation, Newman-Saylor & Gregory, Ashland Oil, Young & Rubicam, Burson-Marsteller, the U.S. Army Recruiting Battalion-Columbia, the S.C. Bar, the Independent Banks of S.C., Marketing & Communications, The Carson Group, Rosica & Mulhern and The AdCouncil.

The campaign had four basic goals: (1) to communicate to business, education and community leaders the implications of South Carolina’s 33 percent dropout rate, (2) to motivate business, education and community leaders to develop and implement significant dropout prevention initiatives, (3) to make business, education and community leaders aware of the commitment to education of sponsoring groups, and (4) to encourage the use of resources available from the NDPC and other agencies by partnerships in the state.
The campaign was funded by grants from the state’s major utilities: Carolina Power & Light, Duke Power and SCANA Corporation. Additional in-kind commitments brought the total dollar value of the campaign to approximately $75,000.

During the course of the campaign, more than 2,000 students and teachers participated in the school contests, 10,000 “partnership” brochures were distributed, 300 business and community leaders participated in workshops and seminars, 100 print and 200 broadcast PSA’s were run, 100 “partnership” handbooks were distributed, 250 calls for information about partnerships were received by the center, contacts were made with 50 key legislators in the state, and spin-off campaigns were generated in at least three South Carolina counties and in Colorado.

Action-Oriented Research

Funded by a $900,000 grant under the Cooperative Demonstration Dropout Prevention Program in the Office of Vocational and Adult Education of the U.S. Department of Education, the National Dropout Prevention Center is involved in a three-year project seeking to demonstrate the viability and effectiveness of taking a model dropout prevention and reentry program (called COFFEE) and adapting it to various settings. In addition to NDPC staff and the school district personnel of the target locations, the project also involves professional staff from the Center on Education and Training for Employment (CETE) at The Ohio State University.

As a result of this project, the number of students dropping out of school should be reduced and vocational education should assume a more active and aggressive stance in recruiting and enrolling students. The project will produce a powerful and comprehensive curriculum for all students, thereby reducing potential dropouts.

The center provided support for three action-research projects in South Carolina during 1989-90. One involved Kershaw County, in many ways a microcosm of South Carolina. Traditionally an agrarian community, the county’s economic base is shifting rapidly to manufacturing and information. To meet the concomitant demands on the workforce, Kershaw County must take steps to ensure that every student completes basic education. Presently, only one out of every four ninth graders will graduate with his or her classmates. In 1988, 35 percent of students taking the state’s new “exit exam” failed. And, perhaps most significant of all, only one-half of the adult population graduated from high school.

With fiscal and technical support from the National Dropout Prevention Center, the School District of Kershaw County established a coordinated program of early identification of at-risk students and an intervention program for grades K-12. The project incorporated community-based partnerships, promotional activities, community-wide advisory groups, staff development opportunities and alternative educational opportunities for at-risk youth.

Another project centered in Rock Hill, which is located in York County, just across the South Carolina/North Carolina border from Charlotte, perhaps one of the most progressive cities of the New South. The area reflects that progressiveness. Outstanding efforts have been made in developing school/business partnerships. However, there were still “gaps” in the service delivery to at-risk youth. To help close these gaps, the National Dropout Prevention Center provided partial support to develop a community-based strategic plan to address the needs of at-risk students.
Approximately 25-30 percent of York County School District Three’s student population leaves school before graduation. It was anticipated that a community-based, multi-agency approach for identification and meeting the needs of at-risk youth would greatly enhance current efforts. Approval of the strategic plan by the School Board is expected in August 1990, with implementation of that plan during the '90-91 school year.

Studies have clearly indicated the value of a personal, one-to-one approach (such as mentoring or tutoring) in dropout prevention. With support from the National Dropout Prevention Center, Anderson School District One developed a comprehensive tutoring program for at-risk youth during 1989-90. Serving more than 700 students, the per student cost of this effort was approximately $35.50. The effort involved more than 400 volunteer tutors (teachers, university students, retired persons, etc.) providing almost 7,000 hours of tutoring. To meet the needs of as many at-risk students as possible, the program included in-school and after-school tutoring sessions and served two high schools, two middle schools and seven elementary schools.

These efforts clearly demonstrate the National Dropout Prevention Center’s commitment to its home state of South Carolina and to participating in action-oriented research projects in an effort to fulfill its mission of reducing America’s school dropout rate.

The Year at a Glance

The following statistics give an overview of the extensive involvement of the National Dropout Prevention Center in dropout prevention efforts.

- Responded to more than 2,500 inquiries.
- Served clients in all 50 states.
- Served clients in eight Canadian provinces, in England, Australia and Japan.
- Increased the number of program abstracts in FOCUS to more than 400.
- Made 83 presentations in 11 states to more than 5,000 educators, business leaders and community representatives.
- Co-sponsored the National Dropout Prevention Conference in Nashville, Tenn., attracting more than 1,000 participants, a regional at-risk conference with Francis Marion College in Charleston, S.C., and an alternative education conference at Stanford University at Palo Alto, Calif.
- Responded to more than 110 media inquiries.
- Reached millions of viewers with appearances on NBC, CBS, ABC and CNN news programs.
- Reached thousands of listeners with appearances on more than 10 regional talk shows including that of Governor Celeste of Ohio.
- Affected legislation in 15 states by providing expert testimony and technical advice to legislative bodies.
- Coordinated a statewide promotional campaign in South Carolina that reached more than 2,000 students and teachers, every superintendent and principal, 50 key legislators and hundreds of business and community leaders.
- Distributed more than 30,000 publications.
• Funded three South Carolina action-oriented demonstration projects focusing on strategic planning, volunteer tutoring of at-risk students and increasing community awareness and involvement.

• Coordinated a three-year federally funded action-oriented demonstration project in Florida, Maryland and South Carolina.

• Served on eight national advisory boards and/or councils.

The Strom Thurmond Institute

The Strom Thurmond Institute is the main program component of The Strom Thurmond Center for Excellence in Government and Public Service. The institute is responsible for the conduct of six programs:

1. The Thurmond Seminars in Government and Politics
2. The Strom and Nancy Thurmond High School Achievement Program
3. Institute Lecture Series
4. Distinguished Lecturers Program
5. Visiting International Scholars Program
6. Public Policy Research

Public Programs

During 1989-90 the institute presented more than 40 public lectures, conferences and seminars covering such diverse topics as climate change, corporate mergers and leveraged buy-outs, health and medical care, community and economic development, land and water resources management, emergency preparedness planning, world hunger, terrorism and arms control. More than 10,000 copies of institute lectures and proceedings of these programs were distributed, and most of these programs were videotaped and made available to other educational institutions, including the public schools.

The institute sponsored statewide teleconferences in 1989-90 on the subjects of wetlands protection and water management issues. The institute co-sponsored the sixth annual statewide conference on volunteerism at Hilton Head Island, S.C., in November 1989. Also, the institute co-sponsored a Southeastern regional conference on groundwater issues in October 1989. More than 60 papers were presented to an audience of 300 experts in this subject matter, with proceedings of the conference published in the fall 1990.

For the third year, the institute cooperated with state energy offices, the National Association of State Energy Officials and the U.S. Department of Energy in offering regional seminars on energy emergency preparedness in California, Louisiana, Missouri and New Hampshire.

In November 1989 the institute co-sponsored “A Historic Evening with the Governors of South Carolina.” The program featured a two-hour roundtable discussion with the nine living governors of South Carolina, followed by a reception and dinner in their honor attended by more than 750 persons. The panel discussion was videotaped and broadcast statewide on SC ETV in January 1990 immediately following the Governor’s State of the State Address.
The institute continued to co-sponsor the annual workshops for newly elected municipal and county officials with the South Carolina Association of Counties and the Municipal Association of South Carolina.

Institute staff presented a number of seminars on their publication *Hurricane Hugo: Lessons Learned in Energy Emergency Preparedness*, published in February 1990. In November 1989 the institute inaugurated the Harris Page Smith Memorial Lecture Series in South Carolina Local Government to honor the late Pickens County State Senator for his efforts on behalf of local government in the state.

**Community and Economic Development**

In July 1989 the institute undertook a joint program with the Cooperative Extension Service and the Agricultural Experiment Station, both at Clemson University, to offer the CED program. This new program is intended to harness the unique capabilities of the three sponsors to (1) improve the efficiency of government services, (2) enhance knowledgeable participation in civic affairs, (3) expand economic opportunities, (4) achieve orderly adjustments to social change, and (5) provide for a safer, healthier and more pleasant environment. These objectives are accomplished by consulting with local governments and state agencies on a variety of topics, doing research directed to questions posed by local officials, and expediting the transfer of scientific and technical knowledge to those who have practical need of it.

The first issue of a quarterly newsletter has been circulated to more than 15,000 grassroots leaders across South Carolina. Current research and program efforts are focusing on rural education and impediments to delivery of health care to rural areas, as well as work on community infrastructure (water, sewer, roads and facilities).

**Energy Planning**

The institute announced in January 1990 establishment of the Energy Planning Program, which builds upon the previous four years of work in energy emergency preparedness. Through this program, the institute is providing technical assistance to numerous states and U.S. territories in developing comprehensive energy plans, developing basic and applied research, planning documents, development and sharing of databases, and in facilitating interaction of state and federal governments with the energy industry.

**Visiting International Scholars Program**

Since this program was established in January 1989, six scholars from academic institutions and government agencies abroad have been in residence at the institute, pursuing a variety of research projects. These include government officials and scholars from Australia, the Republic of China, Colombia, India and Nepal.

In June 1989 the institute hosted visits of four representatives of the Tainan District Court, Taiwan, Republic of China. This delegation visited the United States to study the application of computers in the American court system.
Public Policy Research

During 1989-90 the institute entered into research contracts totaling more than $750,000 for work in local government planning, water policy, energy planning and development of geographic information systems.

The South Carolina Development Board granted the institute $165,000 in late 1988 to develop a GIS system for infrastructure for South Carolina, and that work continues in its second year. The institute continued work for a sixth year for the South Carolina Water Resources Commission, examining in 1989-90 the water resources of the Savannah River Basin and developing a prototype countywide water system, using Oconee County as a test case.

Grants were received from Anderson County and Pickens County to assist those counties' planning and development boards in land use planning and, in the case of Anderson County, in structuring alternatives for expanding local government services to the community of Powdersville. The institute entered agreements to assist more than a dozen states in revision and testing of their state energy emergency preparedness plans, and full-scale simulation exercises were conducted for Hawaii, North Carolina and the Virgin Islands.

Publications

In addition to publishing several of the lectures and proceedings of seminars and conferences, the institute published eight major research reports on the research projects described above.

The institute also published *Hurricane Hugo: Lessons Learned in Energy Emergency Preparedness* in February 1990. This report is the first of its kind, and 2,500 copies were made available to the energy community, including federal, state and local government agencies. The report described planning efforts in advance of the hurricane, the immediate response of government agencies and the public utilities in North Carolina and South Carolina, and efforts to restore the massive destruction done by the storm to the energy infrastructure in these states.

Work continued on *Energy Emergency Preparedness: Guidelines for State Planning*, commenced in 1989 during the institute's second round of regional seminars on energy emergency preparedness. The document has been described by energy planners as "the most comprehensive and useful document available in the energy emergency preparedness field." It is scheduled for publication in the fall of 1990. The institute published in July 1990 *New Perspectives on Energy Emergency Preparedness*, which sets forth a suggested agenda for policy makers in this vitally important public policy field.

The institute is currently preparing for publication the proceedings of two major conferences. Proceedings of a teleconference, "Protection and Management Issues for South Carolina Wetlands," will consist of seven presentations with commentaries. Sixty papers make up the forthcoming publication "Ground Water in the Piedmont of the Eastern United States."

In the fall 1990 the institute will publish the proceedings of a conference, co-sponsored with the Southeast Regional Climate Center and the South Carolina Water Resources Commission, on climate change, including the status of research efforts,
modeling techniques and potential impacts of climate change in the Southeast and the Caribbean basin.

Proceedings of "A Historic Evening with the Governors of South Carolina" were published in March 1990. The inaugural lectures in the Harris Page Smith Memorial Lecture Series in South Carolina Local Government were published in August 1990. The institute's 1989-90 annual report was published in August 1990.

**Activities for 1990-91**

The institute will continue to offer a high quality and diverse series of public programs (lectures, conferences and seminars) during 1990-91. The institute will continue to emphasize its research capabilities in the areas of community and economic development, environment, natural resources, water policy, energy planning, and state and local government. An integrated approach to natural resources issues — combining water, energy and economic development, along with attention to community infrastructure — will enhance the institute's effectiveness in assisting state and local government agencies in South Carolina to cope with rapid growth while giving appropriate attention to quality of life issues and environmental concerns.

As of July 1, 1990, institute research grants and contracts accounted for approximately two-thirds of the institute's funding.

**Undergraduate Studies**

The Undergraduate Studies Office is responsible for undergraduate academic programs and curricula, academic standards, scholarships and awards, university-wide lectures, new faculty/staff orientation, summer sessions, the Clemson Career Workshops, the Junior Scholars, the Science and Technology Entrance Program, the Calhoun College honors program, Cooperative Education, special post-graduate scholarship programs and special University ceremonial occasions.

The Clemson Career Workshops continue to be a primary recruiting program for minority high school students. The University expects 50 new freshmen recruited by this program to enroll in the fall of 1990.

The Honors Program reached an all-time high of 651 students in 1989-90. Fifty-two students graduated with Senior Departmental Honors in December, May and August. Two Clemson students received Fulbright Scholarships for foreign-country study in 1989, bringing the number to 33 in the past 10 years.

The Science and Technology Entrance Program, designed to aid marginal students in agriculture, forestry, textiles and industrial education technology to have meaningful access to Clemson University, has received an award as the outstanding program in South Carolina for 1988-89 and an award as the outstanding program in the United States for 1989-90.

Cooperative Education continues to be a leader in our region. More than 625 students participated this year. The Junior Scholars and Summer Science and Engineering programs bring academically talented students between the ninth and twelfth grades for summer enrichment programs on campus. Now in its sixth year, this program enrolled 324 students in the summer of 1989. The 1989 summer sessions generated a record number of more than 38,000 credit hours.
In special activities, Undergraduate Studies completed its direction of the Centennial with a variety of events, including a lecture by William F. Buckley Jr., a student Thanksgiving Feast and a closing Town-Gown party on November 27, 1989.

DIVISION OF ADMINISTRATION AND SECRETARY OF THE BOARD OF TRUSTEES

The Division of Administration was created August 1, 1985, in conjunction with the Secretary of the Board of Trustees. The fundamental responsibility of the Administrative Division is to formulate, monitor and coordinate fiscal matters for the Office of the President as well as other areas of University administration. The vice president for administration assists the president in discharging his general administrative and executive functions and represents the president during his absence. The secretary of the board reports directly to the Board of Trustees. He records all proceedings of the board and its committee meetings, is the custodian of the University seal and all records of the board, and performs other duties as may be assigned by the Board of Trustees.

The vice president for administration supervises the director of public safety, who oversees the Fire and Police Departments; the assistant vice president for human resources, who is responsible for the Center for the Study of the Black Experience; the Department of Parking and Vehicle Registration, which is an auxiliary department; and the Office of Public Affairs. The University municipal judge relies on this vice president for administrative and logistical support.

The internal auditor is under the cognizance of the secretary of the board of trustees, who, in turn, reports directly to the chairman of the board.

A report on each unit of the division follows.

Fire Department — Emergency Medical Service

During 1989-90 the Fire Department responded to 412 fire alarms compared to 484 the previous fiscal year. Of that number, 34 percent were off-campus fire alarms. Three hundred and fifty-four emergency medical alarms were answered. A total of 1,749 man-hours were spent responding to emergencies.

On-campus fire property damages for this reporting period totaled $9,600. Property damage in the city of Clemson was $122,500. One civilian was injured by fire-related alarms during the fiscal year. No loss-time injuries were sustained by firefighters. There were no fire-related deaths.

A vacancy in the fire marshal’s position permitted the hiring of an experienced deputy state fire marshal, who had previously been employed as a CUFD-EMS firefighter. His strong building and fire code background will be an asset in maintaining compliance with fire safety standards.

Increased awareness of dormitory fire safety has resulted in a steady decline of malicious false fire alarms and fire system vandalism. Considerable time has been spent working with the Housing Office to upgrade emergency lighting and backup power for exit lights in the dormitories.
A total of 4,110 man-hours were spent training CUFD-EMS firefighters. In addition to fire suppression skills, personnel received monthly training in hazardous materials from Capt. Lew Riley and monthly D.H.E.C. approved medical training.

Personnel turnover during 1989-90 was 15 percent (one retirement and two resignations). Efforts to attract a qualified minority candidate to fill a firefighter's opening were successful.

The Commission on Higher Education approved funding for one-half of a five-year lease-purchase of a fire truck to replace a 29-year-old truck. The city of Clemson has agreed to match the funding as consideration to extend the fire service contract for five years.

Members of the CUFD-EMS gave presentations at a national fire protection conference in Seattle, Wash., and several state conferences. Additionally, three articles written by the fire chief were published in national fire service trade magazines.

**Center for the Study of the Black Experience in Higher Education**

The mission of the center is to increase participation of African Americans in higher education in South Carolina and the nation. To accomplish this, the staff has been actively involved in fund raising to support the four components that make up the framework of center activities: dissemination, demonstration, research and evaluation.

To disseminate information collected through research by the staff as well as research associates at Clemson University and other state institutions, a newsletter, *Challenge*, was developed. The first issue has been printed and distributed.

A program designed to target certain entry-level students who were determined to be "at risk" has been field-tested at Morrison Elementary School in Clemson and has now become a demonstration project, with funds for its continuation and expansion being solicited from major outside donors.

Evaluation and review of procedures used in other states to increase minority participation is on-going, with results being published in the *Challenge* as well as being directed to various departments.

**Human Resources**

The Office of Human Resources coordinates and directs the University's affirmative action and desegregation plan efforts. The department is actively involved in recruiting black faculty, staff and graduate students, mediating pre-grievances based on alleged illegal discrimination, conducting an educational and counseling program for sexual harassment, being responsible for state and federal statistical reporting, and developing projects to meet the objectives of equal opportunity and desegregation.

For academic year 1989-90, the University had 32 blacks with faculty status, including five administrators. This represents an increase over the previous year by three black administrators and three non-administrative faculty. Black administrative staff increased by four, and black professional-level staff increased by five. Black graduate students increased from 137 to 170 in 1989.
**Internal Auditing**

The staff of the Internal Auditing Division consists of eight members: an associate vice president, an audits manager, an EDP audits manager, three staff auditors, a business associate and a half-time word processing operator. The associate vice president reports administratively to the secretary of the board of trustees.

The division provides an ongoing, independent audit function for the University as a service to management. Audit parameters include financial, compliance and operational review, as well as special requests.

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**Municipal Judge**

The staff of the University’s Municipal Court consists of two judges, one full-time judge who serves as department head, and one part-time judge who serves in the absence of the chief judge and on weekends and special occasions. Also, the staff includes a clerk of the court and one student secretary.

Formerly known as the University recorder, the judge for the municipality of Clemson University hears appeals and renders decisions on all campus parking violators brought before the court, tries all persons charged with violating any ordinance passed by the Board of Trustees and any state laws that fall within the jurisdiction of the municipal judge (any crime or traffic violation for which the maximum penalty that can be imposed does not exceed $287 or 30 days in jail). The municipal judge also issues bench warrants, search warrants and arrest warrants for incidents arising on campus.

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**Parking and Vehicle Registration**

The Department of Vehicle Registration is responsible for managing the parking program for Clemson University. This responsibility includes maintaining parking spaces and lots, planning and implementing construction of new parking lots, vehicle registration and maintenance of parking violation records. For 1989-90 the department issued 19,926 decals and deposited $196,098 from the sale of decals. For the same period, 48,894 parking citations were issued by the University Police Department, generating $528,822 in revenue.

A shuttle bus operation was continued by the department during fall 1989. New shuttle buses with seating capacity of 16 passengers were rented from the University Motor Pool. Drivers included students and Crowe Security officers. The shuttle service operated during the fall and spring semesters and transported approximately 370,000 riders. Cost for the service, including drivers and van rental, was $80,919.40. The average number of riders per day was 2,164, and the average cost per rider per day was .24.

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**Police Department**

During 1989-90 the Police Department responded to 9,199 calls for service, a 51 percent increase over last year. Crime rate statistics reported in SLED’s *Crime in South Carolina 1989* indicated a 50 percent increase in violent crimes and a 2.1 percent decrease in non-violent crimes reported at Clemson University in 1989. During this same period, crime reported in Pickens County increased 3.6 percent and 11.9 percent
in violent and non-violent crimes, respectively. The significant increase in violent crimes on campus is attributed to the 15 cases of aggravated assault, the majority of which involved non-student gang members.

Police efforts during the year resulted in 275 arrests and $26,731 in fines resulting from convictions. In addition to normal activities, the department provided services for 173 special events. Hurricane Hugo was responsible for the loss of S.C. state troopers to assist in traffic at one of the home football games. Greenville city officers were used for the first time to assist with traffic for the football game and also for the Rolling Stones concert, an event which resulted in the largest-ever number of automobiles parked on campus.

**Investigative Division**

The Investigative Division assembles facts and evidence to document a reported incident, identify offenders and assist in the administration of justice. This division also performs background investigations, coordinates the protection for VIP’s to campus when requested and helps present public safety programs. Investigator Mac McCrary was promoted to captain and now heads the Investigative Division. Significant accomplishments of the division include:

- Investigated the accidental death of Shannon Gill and assisted Alcohol Beverage Commission agents in their subsequent related investigation.
- Participated in department efforts to identify and remove non-student gang members from campus.
- Provided protection for nine dignitaries, including Martin Luther King III and Secretary Elizabeth Dole, during their visits to campus.
- Performed 144 background investigations for University departments — a 69 percent increase in requests for this service over last year.
- Supervised the activities of Pre-trial Intervention participants, who provided 715 hours of public service to various University departments.
- Provided in-service training to investigators in various topics and operated with an average case load of 137 per investigator. Follow-up investigations resulted in 55 arrest warrants being obtained for criminal prosecution.

**Uniformed Patrol Division**

Uniformed patrol officers move about campus to deter and detect criminal activity, preserve order, direct traffic, investigate accidents, and enforce state laws and University parking regulations. Additional services provided by the division include transporting sick/injured students to the infirmary, monitoring intrusion and fire alarms, providing dispatch service for fire and EMS and evening dispatch service for FMO, and maintaining traffic signs and street markings. Significant accomplishments of the division include:

- The traffic safety program provided defensive driving instruction to 485 campus citizens and provided in-service training for officers in emergency vehicle operation. A total of 1,107 traffic citations were issued, which resulted in fines totaling $45,866.
Parking enforcement efforts resulted in 48,894 citations being issued from July through April. The additional parking enforcement officers hired during the year and the additional use of computer ticketing machines provided parking enforcement services which were more consistent throughout campus areas. The officers have not received the additional three-wheel parking enforcement vehicles requested to maximize their effectiveness.

Preventive patrol efforts required additional working hours assigned to officers and investigators due to the unrest created by the Lander College incident and the non-student gangs. During the year, 3,659 escorts were provided to campus citizens.

**Crisis Response Team**

- The team assisted in the successful resolution of a barricaded hostage situation at Shoney’s Restaurant in the city of Clemson.
- Training for team members averaged 42 hours per member, which included time spent in practical problem training with other response teams.
- Mutual aid agreements were implemented with the Pickens County Sheriff’s Office and other municipal law enforcement agencies in the county.

**Administrative Division**

The Administrative Division is responsible for developing and presenting public awareness programs, supervising student police officers and working with victims of crime by providing services and information to help them cope with the criminal justice system and the stress caused by victimization. Significant accomplishments of the division include:

**Public Safety Programs and Services**

- Provided safety programs to more than 2,000 campus citizens.
- Completed and updated security surveys for University departments.
- Published four papers by the USC College of Criminal Justice: Crisis Response, Victim Witness Programs, Computer Composites and the Development of Security Surveys. Two of the papers received the Innovations in Law Enforcement Award, making this the second consecutive year in which the award was granted to this department.
- Participated in a television presentation of “C.U. Video Magazine” concerning acquaintance rape.
- Participated in the implementation of Neighborhood Watch, a crime prevention program for Douthit Hills residents.
- Provided victim/witness services to 793 campus citizens. The grant allowing for program continuation has been extended through the coming year.
Plans for the coming year include developing an Acquaintance Rape Manual and forming a Social Awareness Committee using funds awarded by the University Innovations Fund Committee.

**Student Police**

- Student police officers provided 2,003 hours during special events, 1,352 hours painting street markings, 2,404 hours of special surveillance and 4,733 hours for athletic events, traffic direction, parking enforcement, dispatch and VIP transport services.

The department is developing software for the National Incident Based Crime Reporting System. The replacement of outdated and unreliable communications equipment remains to be done. New training laws with mandated training requirements and documentation have increased the need for additional computer programming to reduce administrative record-keeping time. New training schedules have been formulated to assure that department members are prepared to meet the increasing public safety needs of our campus population.

**Public Affairs**

The Office of Public Affairs maintains contact with the S.C. General Assembly and state regulatory agencies. The president is provided counsel and advice on activities of the General Assembly by the director of public affairs.

A continuing task for the Office of Public Affairs is to maintain a University presence in the capital city by serving in a liaison capacity with central state government. Furthermore, this department is committed to enhancing the image of higher education with the legislative and executive branches of state government and the public.

**BUSINESS AND FINANCE**

Business and Finance is responsible for determining the broad policies of institutional functions relating to administration, business and finance, and for managing specific administrative, fiscal and auxiliary functions. These departments are comprised of more than 1,000 full-time, part-time and contract employees responsible for managing financial resources in excess of $72 million.

The following are highlights of the goals achieved in 1989-90.

**Governmental Relations and Communications**

Working in cooperation with other members of the campus community, Business and Finance helped enhance Clemson’s relationships with a variety of Clemson constituencies. Members of the Business and Finance organization increased their efforts to establish and renew contacts among strategic state agencies. Communications with members of the Joint Bond Review Committee have been improved, particularly in the
facilities area. Progress also has been made in establishing contacts and relationships with respect to budget and procurement issues. An interadministrative team produced the third annual President's Report, as well as the first annual award-winning Research Report for the Office of the Vice President for Research. A supplement to the new financial report also was published.

Efforts to improve communications with a broader cross section of the University also were made. A Management Letter was initiated to inform the campus about faculty salary and compensation issues, budgets, formula funding and Business and Finance accomplishments. A newsletter, C Unite, was initiated by Business and Finance to keep the campus informed about three processes important to the future of the University: strategic planning, the upcoming self-study for reaccreditation and assessment of institutional effectiveness. The second edition of the University's Fact Book was produced and distributed by the Office of Institutional Research. A budget analysis fact book was produced for University-wide distribution.

Two new publications were produced for campuswide distribution to give University employees easy access to University policies and procedures. These publications are Travel Policy—An Employee's Travel Guide and Departmental Business Management—An Executive Summary for Department Heads. Both publications will be updated and redistributed during 1990-91.

Special meetings have been held with academic department heads and individual faculty to encourage discussions on a broad range of budget, research and personnel issues.

### Strategic Planning

The strategic plan for Business and Finance was revised, and an update on the campus master plan was initiated. Academic departments received assistance in integrating their Second Century and other plans with other budget priorities. The Planning Office helped the University's Strategic Planning Committee and the Environmental Scanning and Futures Research Subcommittee identify issues of particular importance in revising Clemson's Second Century Plan. Nationally known consultants were brought in to speak to faculty and key administrators about planning, self-study and assessment. The office created a newsletter — C Unite — to communicate strategic planning, self-study and assessment activities to the campus, and helped faculty prepare presentations for various campus constituencies.

### Budgets and Financial Planning

Clemson University began its second century of operation with a budget exceeding $300 million for 1989-90 — an increase of $45 million over fiscal year 1988-89. Higher education institutions received only 91 percent formula funding, compared to 93 percent in 1988-89. Clemson's state appropriations increased $6.2 million in Educational and General funds and $3.7 million in Public Service Activities, resulting in a $9.9 million total increase from state appropriations. The state of South Carolina continued its commitment to funding higher education research, scholarships and other programs by investing $5 million in Cutting Edge funds.
Clemson begins 1990-91 with a budget exceeding $315 million. Higher education institutions will receive only 87.6 percent formula funding. The University's state appropriation increase amounts to $6.6 million in Educational and General funds and $1.1 million in Public Service Activities, resulting in a $7.7 million increase from state appropriations.

The University has strengthened its financial foundations by integrating long-range planning priorities with the budget process. Block funding, an innovative approach to allocating operating and equipment funds, was introduced to the campus for the first time in 1989-90. This approach shifts more fiscal responsibility and flexibility to the colleges and divisions. Emphasis has been to develop a functional orientation toward budgeting activities and to provide support for strategic planning, self-study and assessment activities. The block funding model is under continual refinement to maximize the effectiveness and efficiency of the University's budget activities. Individual meetings were held with each dean to discuss Budget Office support services and block funding issues. In addition, the Budget Office has conducted several seminars with colleges and divisions explaining the CHE formula and the block funding model.

New permanent FTE positions (288) authorized by the state were established with the state Office of Human Resources Management. Funding source updates were processed with Human Resources Management to reflect 1990 funding for the 4163.83 FTE positions authorized to the University. The Budget Office continued to update the FTE position database, which contains historical data on positions and funding from 1986 forward.

Annual budget requests were prepared and submitted to the state, and University operating budgets were prepared reflecting the allocation of resources approved by the administration and Board of Trustees.

The first annual Budget Analysis Fact Book was released in draft form in July 1989 and final form in January 1990.

A model and resulting guidelines for the distribution of "performance credits" were developed. Calculated performance credits were distributed to budget centers.

The Budget Office helped establish guidelines for the Innovation Fund Awards. The recently established Innovation Fund Awards Committee awarded more than $700,000 to faculty and staff in response to proposals submitted during two rounds of funding. Guidelines were developed for billing University departments for certain Business and Finance services, including Printing Services, Facilities Maintenance and Operations, Telecommunications, Risk Management and Safety, Postal Services and Transportation Services. Based on these guidelines, preliminary billing rates were developed for Facilities and Transportation Services operations.

The Budget Office continued the evolution of its "shadow" formula database to that used by CHE to determine the economic impact of formula revisions developed by Clemson.

The indirect cost proposal was prepared and submitted to the Department of Health and Human Services. The proposal included an analysis of University costs as well as a space-utilization study.
Sponsored Programs

The Office of Sponsored Programs Administration administers resources received through sponsored programs (contracts, grants and cooperative agreements) in a manner consistent with prudent fiscal policies, sound management practices, and all policies, procedures and laws regulating such activities. During 1989-90, sponsored program awards again showed substantial increases from the previous year, and although 1989-90 figures have not yet been finalized, awards are expected to exceed $27 million. In addition, expenditures in excess of $18.5 million are anticipated.

In August 1989 the W. K. Kellogg Foundation of Battle Creek, Mich., gave Clemson University $2.97 million to support the project “Visions for Youth.” This is the largest grant ever received by Clemson University from a private foundation. This education program is designed to assist today’s youth facing problems such as drug abuse, teen pregnancy and academic underachievement. Tested first in pilot counties, this grant will be expanded to benefit youths throughout South Carolina.

A new partnership was formed in the spring of 1990 between Clemson University, the University of South Carolina, the Medical University of South Carolina and South Carolina State College. The South Carolina Universities Research and Educational Foundation (SCUREF) will be supported primarily from federal (DOE) funds. The foundation will address issues of mutual concern with the Westinghouse Corporation relating to their Savannah River Operations Facility. The primary focus will be on environmental studies. Once in full operation, it is estimated approximately $2 million will be generated annually.

Business and Financial Affairs

This program area provides the campus with goods and services through Accounting Services, Business Affairs, various auxiliary enterprises, Transportation Services, Purchasing and Supply Services, printing and mail services, and various management and financial support services. Emphasis during the year has been to reduce paper flows and to evaluate policies and procedures, reporting mechanisms and internal controls. Projects were implemented to track lapsed salary savings, revise the University Fiscal Policies and Procedures Manual, produce reports for campus distribution on travel policies and a guide for department heads, evaluate various accounting and reporting systems, and determine the campus exposure to unrelated business income tax. A request for proposals was developed to conduct an assessment and systems evaluation for all University business systems. The systems review and an organizational review are being conducted by Deloitte & Touche.

Business Affairs

During the advance bill period, a record 10,333 students prepaid for the fall semester and 9,304 for the spring. Efforts continue to improve the registration/fee payment process to streamline student activities. Additional staff were hired to expedite transactions and reduce student waiting time. The Bursar’s Office was renovated to improve service to the campus. A business associate was hired to reduce the amount of outstanding debts, while maintaining the University’s positive public image with former stu-
dents and alumni. Several programs have been automated to improve service: Perkins promissory notes, utility bills, freight charges, transcript holds on delinquent Perkins borrowers and reconciliation of returned checks.

Accounting for Related Organizations

The fiscal year 1990 marks the first full year on the new accounting system for Related Organizations. In December 1989 Related Organizations converted data sets to a new accounting system, which will provide more flexibility in reporting and a number of other improvements. In cooperation with Administrative Programming Services, Related Organizations developed a program to load report files for report generation from the PC-based accounting system to the Clemson University mainframe. This improved efficiency, quality and accessibility of reports. Long-term plans were initiated to convert the accounting for Related Organizations to the mainframe through participation in the business system study. Several training sessions were held in 1990 on Related Organizations accounting policies and procedures. A fixed asset system was implemented to control tangible property for each related organization. A computer policies and procedures manual and a resources manual for internal operations were developed. Investment policies and procedures for the University also were drafted.

Related Organizations also assumed responsibility for the accounting functions of the National Dropout Prevention Center, assisted the Clemson Alumni Association in evaluating and selecting a tuition prepayment program, began tracking investment and endowment activities in a new allocation/portfolio tracking system, and developed various policies and procedures for the University and related organizations.

Purchasing and Supply Services

Purchasing and Supply Services serves and supports the entire University in the procurement of goods and services, information technology and consultant services. In June 1990 Clemson University became the first state agency to have its across-the-board certification limit increased to $100,000.

During 1989-90 the Purchasing Department issued 1,163 bids and processed 6,710 purchase orders at a value of $45.3 million. Various agency contracts have been established to allow volume buying and reduce processing time. The University Receiving Station processed 65,144 incoming shipments. The Office and Janitorial Stores operation processed approximately 5,243 orders during this period. The Property Control Office held four sealed-bid sales during 1989-90, yielding $12,812.64. Clemson University has also received $34,326.27 from the state for the sale of excess property.

Accounting Services

Accounting Services offered a series of four different University-wide workshops to improve departmental understanding of existing and new accounting policies.

Priority has been placed on streamlining and expediting the payment process. The automated use tax payment process has reduced processing effort and improved reporting schedules. Plans to change to self-contained check payment mailers will save time and postage. Other disbursement processes are being evaluated and automated.
A review of the tax regulations over the past 18 months resulted in cost savings to the University, as well as more than $50,000 in refunds.

**Auxiliary Services**

**Dining Services**

Participation in the University’s dining services increased by approximately 500 people. More than 9,300 students participated during the fall semester. Dining options added during the fall include two new meal plans and a Treat Yourself Right (TYR) Program, which includes healthy low-calorie meals. In addition, a quarterly newsletter with monthly promotions was initiated, and the Clemson House dining facility was renovated. A new five-year contract for dining services was negotiated and awarded during the year.

**University Laundry**

The laundry service completed plans for the renovation of the entrance to the facility and enhancements to the cooling system. New services offered since July 1, 1989, are the renting of table linen, pick-up and delivery service of linen to each dorm during the summer conference season, and towel rental to ARA.

**University Vending**

Approximately 25 vending machines were added on campus during the year. Current sales of soft drinks increased by 13.4 percent over the previous year.

**ID Services**

ID Services began implementation of the new University identification card. The new card combines the functions of the old identification cards (Vali-Dine Meal Card, the activities card and the old identification card with the library bar code) into one, credit card-sized package. The new card will allow access to meal plans, debit accounts, Cooper Library, Fike Recreation Center, Redfern Health Center and will allow students to pick up tickets for football games.

**University Bookstore**

In August 1989 minor renovation was completed, without closing the store, which included modernizing the entrance, improving lighting and installing additional cash registers. The bookstore began a summer orientation program for entering freshmen by offering them a textbook reservation service. Approximately 2,200 freshmen participated.

A new gift catalog was mailed to many Clemson University alumni and supporters of the athletic department. The bookstore enhanced its buy-back program to include one-stop selling, remote locations and more buy dates.

A staff development program was implemented where all management staff and most supervisors participated in training courses offered by the National Association of...
Transportation Services

The motor pool fleet size is gradually being increased to include not only daily, but permanent vehicle leases. Vehicles on permanent departmental lease increased from 28 in June 1989 to 80 in June 1990.

The motor pool fleet traveled 2,919,500 miles in 1990, an increase of 18 percent from the previous year.

Student shuttle support improved dramatically during the fall with the addition of seven airport-style shuttle buses to the Clemson fleet. These vehicles replaced 15 aging passenger vans.

Transportation Services personnel played a major role in obtaining state maintenance shop certification for four off-campus shops previously not certified by the state.

Facilities Planning and Management

This program area includes planning, engineering, maintenance and management activities of Clemson University’s facilities, including campus master planning, real estate development, property records and capital building projects.

Progress in campus building and renovation programs continues in line with the six-year facilities plan, representing almost $300 million in projects approved in September 1987. Projects now under construction include the Brackett Hall renovation, East Campus housing, the Academic Learning Center, and the Show and Sale Arena. An animal research compliance facility, the Johnstone Hall renovation, the Engineering Innovation Building and the Performing Arts facility are in the design phase. A request for proposals is being prepared for a new conference center. Several new projects are scheduled for agriculture, including a new insectary, replacement of a fruit research station, and renovations to Newman Hall and Poole Agricultural Center. A research building to house the Department of Environmental Systems Engineering in the Research Park is under construction.

A new computer system for facilities is on-line. A space-utilization study is well under way with 75 percent of the buildings surveyed.

Facilities Planning and Management has completed a comprehensive facilities audit. A detailed publication, Budgeting Needs for Adequate Facilities Maintenance and Operation: An Assessment of the Clemson University Endowment, was presented to the Board of Trustees and administrators. Quantifying and funding Clemson’s immediate capital renewal and replacement needs have begun.

Clemson’s campus environment has been enhanced by the addition of 104 security-related walk ramps, 28 emergency telephones, and repaving projects at Shot Gun Alley, Gentry Hall, Perimeter Road, the School of Nursing, East Campus Store and the Strom Thurmond Institute. The class of ’89 senior sidewalk was completed, as well as numerous minor renovations in both academic and administrative buildings, including classroom painting. The repair and reopening of Littlejohn Coliseum was accomplished. New steam lines and an electrical duct back were installed in the Fernow Street area.
A CADD system has been installed, and training classes taught through the College of Architecture were attended by FMO personnel. A recently published user handbook was distributed to the deans, department heads, faculty and new FMO employees. Facilities Planning and Management continues to pursue new and innovative ways to implement projects on the Clemson University campus.

**Human Resource Services**

**Capital Financing**

The Office of Capital Financing manages and directs the University’s long-term capital financing program and financial information system for all present and future University capital projects. Major accomplishments of this office for 1989-90 included:

- Prepared reports and forecasts for the vice president for business and finance forecasting future revenues for capital financing based on projections of student enrollment, student fees and rental revenues.
- Coordinated, with bond attorney, the drafting and passing of legislation authorizing issuance of Auxiliary Facilities Revenue Bonds and legislation increasing the statutory limitation on bonds outstanding to $40 million for Student and Faculty Housing Revenue Bonds and $30 million for Plant Improvement Bonds.

**Payroll and Employee Benefits**

The Payroll and Employee Benefits Office provides service and support in the areas of compensation for employee services, the administration of mandatory and voluntary benefit programs for employees, and the management of the University’s contribution to all benefit programs. Major accomplishments of this office for 1989-90 included:

- Produced a personalized employee benefits booklet for each permanent full-time University employee, *Your Personal Statement of Benefits 1990*, distributed in April 1990.
- Completed the re-enrollment of all Clemson University employees in the state health insurance program by conducting more than 130 group meetings on campus and other selected state locations, two informational meetings to help retirees understand the changes to the retiree insurance program, and assistance of many retirees with the re-enrollment process.
- Worked with Hunt, Dupree, Rhine-Consultants to develop a request for proposal to offer University employees a permanent life insurance program through payroll deductions.
- Conducted the first Clemson University Benefits Fair to explain employee benefits. Approximately 700 employees participated.
- Began the Payroll Procedures Workshop to inform administrative employees of appropriate payroll procedures and to assist in their understanding of the payroll/personnel system. Approximately 250 departmental administration employees attended.
• Implemented a program to provide for advanced payment of earned income credit to eligible employees.

• Revised the VHS orientation tape for new employees due to changes in the insurance program.

• Completed the long-term care open enrollment process by holding seven University-wide meetings. Hosted a Long-Term Care Teleconference for retirees July 11, 1990.

• Developed a new benefits summary for faculty and staff and distributed it to current, prospective and new employees.

Risk Management and Safety

The Office of Risk Management and Safety provides services in the areas of property and liability insurance, loss control, and safety and workers' compensation. Some major accomplishments of this office during 1989-90 included:

• Walter Berry, safety coordinator, was awarded the Distinguished Service Award by the S.C. Occupational Safety Council for outstanding contributions to the safety field. The University received the 1989 safety award in the educational division for an outstanding record for the total employee hours worked compared to accidents.

• Safety seminars on personal job protection, fire safety and accident prevention were organized for employees.

• The Accident Review Board reviewed accidents, screened drivers' licenses for Clemson University employees and provided defensive driving classes for 137 participants. Commercial driving classes were coordinated for 106 employees in preparation for the new commercial driver's license to be issued in July 1990.

• The following manuals were developed and distributed to University departments: Hazardous Waste, Hazardous Communication, Confined Space and Radiation Safety.

• Sixty-one contracts were reviewed, and 285 claims for workers' compensation, automobile liability, tort liability, fire insurance, data processing, comprehensive and collision, and inland marine insurance were processed.

• Clemson University removed 43,645 pounds of hazardous waste at a cost of $153,076.10 in 1989-90.

Personnel Services

The Personnel Services Department serves the employees and administration of Clemson University through a variety of programs and activities. Examples of these programs and services include: employment referral services for all non-faculty (staff) positions; employee relations and assistance programs; retirement administration counseling services; administration of some employee benefits, such as leave, holidays and unemployment; staff development and training programs; policy development and administration; coordination and distribution of the Personnel Policy Manual; maintenance of the official personnel records for the University; maintenance of the person-
nel database and the Division of Human Resource Management’s database; and the administra­tion of the University’s grievance procedure.

Major accomplishments of this department during 1989-90 included:

- Designed and developed a new computerized applicant referral system, including a skills inventory. Referred 7,576 applicants for staff positions.
- Conducted a comprehensive employee training program for more than 2,000 staff employees. All staff personnel were surveyed, and the training program for 1990-91 was revised based on the information received from the survey and from program participants.
- Continued the Pre-Retirement Education Workshops. For the first time in 10 years, the backlog of service credit research was eliminated. The computerized Friendly Retirement Education Database (FRED) and the Optional Retirement Counseling Program were implemented.
- Began initial conversion of the Personnel Manual with the ultimate objective of using the computerized DORIS system to update and communicate the information in the manual.
- Processed more than 22,000 personnel actions.
- Continued the Minority Intern Program with 13 new interns selected for the program. Six have completed the program; seven are currently participating.
- Coordinated the first statewide Clemson University/Technical Education College System Conference.

Wage and Salary Administration

Wage and Salary Administration provides technical assistance in matters of job classification, compensation and occupational/labor market research to ensure equitable treatment of employees. Major accomplishments of this office during 1989-90 included:

- Requested and received expanded authority for 95 additional delegated titles.
- Reviewed 759 reclassification/reallocation and salary adjustment requests, 127 hire-above-minimum requests and 832 dual employment requests.
- Processed 407 new position/update requests and reviewed 147 new positions.
- Computerized more than 350 departmental organizational charts using Org Plus Advanced software.
- Conducted four position description workshops to teach employees how to write effective job task statements.
- Conducted desk audits in 12 counties.

Information Management

Information Management is concerned with the development, coordination and maintenance of Business and Finance programs in the areas of data processing services, networking, telecommunications, records management, word processing, printing,
postal services, institutional research and other related activities. Emphasis has been to direct the evolution and integration of cost-effective information-processing procedures. A special study was initiated to develop a plan to meet the current and future information-processing needs of Business and Finance.

Institutional Research

In 1989-90 the Office of Institutional Research concentrated efforts on supporting the activities of University committees involved in the self-study for reaccreditation by the Southern Association of Colleges and Schools (SACS). Guidelines were prepared for the content and format of the reports required from academic units and principal committees. Data were provided to departments, colleges and principal committees for their use in preparing many sections of the self-study.

The office supports the University Assessment Committee in its activities, including preparing assessment guidelines, drafting an assessment plan for the University and preparing the second annual assessment report for the South Carolina Commission on Higher Education (CHE). The office continues to assist in the preparation of many reports and to review others for content and accuracy. These reports contain data for units and programs within the University and for outside groups, such as The Southern University Group (SUG), a data-exchange group of 27 universities located in the South; more than 30 peer institutions across the nation; and the Integrated Postsecondary Education Data System (IPEDS) reports for the CHE and U.S. Department of Education.

The office prepared its second annual Clemson University Fact Book and updated the electronic fact book available on-line. Summaries of faculty salaries (for internal use and for inclusion in the Oklahoma State Faculty Salary Survey by Discipline, 1989-90) and graduate stipends (SUG and internal use) also were prepared.

A paper was presented at the regional Southern Association of Institutional Research by two Institutional Research staff members.

Telecommunications

The Office of Telecommunications coordinated several changes in the University’s telephone service during 1989-90. Due to recent growth, Southern Bell Telephone Company assigned another exchange number for the University’s exclusive use. To simplify the campus dialing plan, all residence hall telephone numbers will now be 858-XXXX, while faculty and staff numbers will remain 656-XXXX.

The University’s ESSX telephone system was upgraded so that ISDN service, the latest technology in switched high-speed data communications, can be installed on campus.

Telecommunications, in cooperation with the Housing Division and Southern Bell, opened a high technology audio-visual presentation center at the Clemson House. Southern Bell has equipped one of the meeting rooms with $60,000 of audio-visual equipment. Southern Bell plans to use the facility about one day per week to demonstrate the capabilities of the ESSX system to other customers. The room and the equipment are available for University use at all other times.
Telecommunications entered into an agreement with Telecom/USA to provide long-distance operator services and to allow them to install their long-distance facilities into the University system. This will allow Telecom to send incoming calls from their network directly to the dialed telephone number. An emergency telephone system also was installed on campus. Telephones providing instant access to the University Police Department were installed at 28 strategic locations. This system should significantly enhance the safety of students, faculty and staff.

Administrative Data Processing

The Office of Administrative Data Processing continues its effort to improve data entry procedures. Student payments are being processed more efficiently with fewer personnel due to better cooperation in the areas they serve. Decentralization of some data entry continues to support conversion to on-line data entry.

Information Resources

The Office of Management Services now includes a mini-training center equipped with a VCR and tape recorders. A library center with videos and cassette learning tapes also has been established for all network and stand-alone users. A laptop computer is available for checkout on a nightly basis to all Business and Finance personnel. The number of local area networks and users has increased during the past year and continues to grow at a steady rate. This office supports and assists users with personal computer applications and mainframe applications. The areas of heaviest usage continues to be spreadsheet and database applications, document transfer and desktop publishing. A newsletter is published quarterly for Business and Finance users.

University Support Services

University Printing Services

Printing Services provides printing and duplication services to the University. In addition to state-of-the-art typesetting, one- and two-color printing, and high-speed photostatic duplicating, other services include document assembly, finishing, folding, inserting, labeling and bulk mailing. University Printing Services prints and duplicates more than 29 million pieces of paper annually.

Projects completed in 1989-90 include:

- Addition of a computerized Netware 386 Novell network, including four computer workstations and a file server, that allows Printing Services personnel on-line access to the computerized inventory system and the Franklin Estimating System. This will significantly reduce the number of manual labor hours by automating the job-estimating process and computations required for inventory reconciliation.
- Addition of a Xerox 5090 high-speed duplicator with on-line binding and 11x17 duplicating capabilities. Increased machine speed means faster turnaround times for many jobs and reduces offset printing setup time, costs, and negative and plate charges.
• Assignment of a dedicated press operator for the American Multigraphics Model 1962 two-color offset press. This allowed University Printing Services to expand a service that has been limited due to inadequate equipment and personnel. The press also enables printing of enamel-coated paper stocks. These services were previously provided on a limited basis.

• Installation of a ventilation system for the darkroom and typesetting area improved safety conditions. An ongoing safety awareness program continues to reinforce a healthy and safe atmosphere for employees handling hazardous chemicals.

**University Postal Services**

Postal services are provided on campus by University Postal Services. Incoming U.S. mail and on-campus mail are delivered to students via more than 7,500 boxes located in the post office lobby. Stamp and money order sales, parcel, insured, certified and registered mail services also are provided at the lobby counter. Mail pick-up and delivery service is provided to faculty and staff offices. University Postal Services, which processes about 40,000 pieces of mail and 250 parcels daily, continues to develop a variety of automation initiatives designed to improve service and reduce costs.

Projects completed in 1989-90 include:

• The distribution, sorting and metering processes moved to a building located off-campus in the Clemson Shopping Center. This move increased workspace from approximately 450 square feet to 3,500 square feet. Productivity has been noticeably enhanced since personnel now have space to adequately organize the distribution process.

• Training programs for new full-time and temporary employees of University Postal Services were implemented. These programs stress efficiency and productivity. Workshops for campus faculty and staff detailing mailing procedures, in conjunction with the U.S. Postal Service, are being organized to begin in the 1990 fall semester.

• A new postage meter was added to streamline the daily metering process.

**INSTITUTIONAL ADVANCEMENT**

The Division of Institutional Advancement is designed to create and enhance Clemson University’s communication and support programs. The division consists of the offices of University Relations, Communications and External Relations, Alumni Relations, Development and Advancement Services. These units work with the Clemson University Board of Visitors, the Clemson Alumni Association and the Clemson University Foundation to communicate the mission and activities of the University and to enhance its image; to provide service and programming to Clemson alumni and friends and to seek service and broad support from alumni and friends; to attract and manage private financial gifts in support of Clemson’s academic and administrative operations; and to manage the constituent database gift and computer
systems necessary for the aforementioned endeavors to occur. A report on each unit follows.

**University Relations**

Communication is the common theme for the major units and program areas that comprise University Relations. These units provide services in agricultural news and public information, electronic and photographic support, publications and graphics, general public relations counsel, and long-range strategic communications planning for the University's academic and administrative divisions, including the Cooperative Extension Service and the S.C. Agricultural Experiment Station. The newest unit, historic houses, was established during the past year as the University renewed its long-standing commitment to the preservation and restoration of the John C. Calhoun House and other historic structures on campus.

**Agricultural Communications**

When hurricane Hugo blew into Charleston, it brought incredible communications needs along with its terrible destruction.

This department already was busy with a full plate of other projects, such as designing a series of public meetings statewide for the Board of Trustees Agriculture and Natural Resources Committee, developing the first annual report for the Division of Agriculture and Natural Resources, redesigning the *Extension Answers* tabloid, creating a new weekly youth advice column for newspapers in the state, conducting news media training on such sensitive issues as animal rights, expanding the network of agricultural news radio programming, and computerizing the Bulletin Room publication inventory and ordering process.

When Hugo came to town, Agricultural Communications, through the Clemson Cooperative Extension Service, set two objectives as soon as the storm swept through 23 South Carolina counties:

- Contribute proactive and responsive information to the hurricane recovery operation, despite a fractured communications network.
- Make maximal use of an opportunity to increase public understanding and support of Extension’s role.

Within six hours of the storm, Ag Communications news editors had reported and electronically transmitted nine pieces of resource material to newspapers and broadcasters statewide. Three working days later, the news editors teamed with publications editors and graphic artists to report, write, design and rush through a printer 600,000 copies of 12 information sheets. Our Extension news editor distributed those sheets from a rented truck in the 16 hardest-hit counties, collecting vignettes of how Extension functioned in the face of disaster.

The 12 information sheets grew to 28, and the vignettes became a special issue of *Extension Answers*. A 12-minute video of the University’s response followed, produced in collaboration with News Services and the Communications Center.
The department considers both Hugo objectives have been met. The disaster response information program received a written commendation from USDA Extension Administrator Myron Jonsrud and has been used in other states. The program also was honored by the Council for Advancement and Support of Education, winning the Grand Award for public affairs issues programming in the 10-state Southern region.

Despite the distractions of Hugo, the department’s other significant objectives for the year were met.

Notable among those objectives was the series of five meetings held in Greenville, Blackville, Columbia, Florence and Charleston to seek public input into programs of the Division of Agriculture and Natural Resources. The Agricultural Communications Department helped organize the meetings, handled promotion through distribution of 10,000 fliers and six news releases, covered the meetings to report comments of the 81 speakers, and produced a tabloid special report distributed to about 7,500 in the target audiences.

"Ask Dr. Di," the advice column for youths, has been well received by newspapers. A phone survey of 30 dailies and weeklies six weeks after the column’s introduction found 10 papers using the column, eight considering using it and 12 not using it. Additional marketing is in progress.

The department’s year-end statistics continue to reflect growth.

In 1989-90, 447 news releases were issued, a 6.4 percent increase over 1988-89. That total includes 365 Extension releases, an increase of 4.8 percent, and 82 Experiment Station releases, an increase of 13.8 percent. These increases are particularly significant in light of a protracted productivity problem with one area news editor which resulted in termination in April. That position has not been refilled yet.

In radio news, the network of pilot counties receiving six taped stories a week for use in county agents’ radio programs increased from nine to 20. Additional expansion is contingent on funding from the Extension administration.

The department opened 588 jobs during the year compared with 625 in 1988-89, a decrease of 6 percent. These projects included publications, exhibits, displays, slide art, posters and specialty items. Total billing during the year was more than $320,000, an increase of 14 percent over 1988-89. Only $718.38 was for typesetting. Before conversion to desktop publishing, typesetting costs in 1986-87 were $7,857.20, or 4.8 percent of the total publications expenditures. Applying that 4.8 percent to this year’s total costs shows a savings on typesetting of approximately $14,500 during the year.

Three new employees joined the department during the year. Julie Walters-Steele, who had served as a temporary, full-time Extension news editor working on Hugo-related forestry losses, became a publications specialist upon the retirement of Marian Wright after 15 years of service. Susan Kelly is the new Bulletin Room supervisor. Cathy Dalton is the new administrative specialist A.

Electronic and Photographic Services

The Department of Electronic and Photographic Services (commonly known as the Communications Center) provides a broad range of audio and visual production services to support the public service, administrative, development, research and instructional activities of the University.
Services include television, audio, multi-image, photographic, motion picture production, audio and visual teleconferencing, art and graphic support, and audio-visual equipment and resources loans.

In 89-90 the department:

• Produced 518 television program units.
• Produced 44,000 photographs and 32,000 slides.
• Completed 3,027 art and graphics jobs.
• Produced 260 daily “Plant Professor” radio programs and 52 “Living Well” programs distributed to stations statewide.
• Produced 45 multi-image presentations.
• Increased the media library’s holdings by adding 300 titles and averaged over 60 loan transactions per week.
• Complied with an average of 65 requests per week for items from the audio-visual equipment loan service.

Publications and Graphics Services

The Department of Publications and Graphics Services provides services to support the University’s efforts to recruit students, faculty and staff; to provide collateral necessary to meet fund-raising goals; to promote programs and activities; and to project a unified graphic and verbal message.

During the 1989-90 year, the department completed 322 jobs and carried over 86 into the new fiscal year. This count is down from 425 for the previous year due to the department’s continuing concentration on major, priority publications while referring less complicated, non-priority requests to other sources on campus and off.

A total of $657,225 in printing-related expenditures was processed by the department, an increase of $200,000 over that spent last year.

Now that the department has totally converted to desktop publishing, the University is realizing considerable savings in typesetting expenses. Less than 2.5 percent of total printing expenditures went for typesetting. This compares with 5 percent spent in 1988-89, the first year these savings were beginning to be realized. Improved design and production efficiency also has yielded a reduction in use off-campus design and mechanical services. Only 4.7 percent (down from 6 percent) of total printing expenses were used for such.

The 1989-90 year was one of major personnel changes. Anita Albert of Iowa State joined the department in May as director after Deborah Dunning, director for four years, returned to the publications manager position vacated early in the year. The department’s secretary resigned, and a new individual was hired. One graphic designer position also was vacated and, at the end of the year, was in the process of being filled. Highlights of the year follow.

• The final Centennial project, Visions: Clemson’s Yesteryears, was completed and shipped to buyers. This volume contains 144 pages of rare and historical photographs from the 1880s to the 1960s compiled by Dr. Alan Schaffer with production support from Publications and Graphics.
• Collateral materials for the November 1989 kickoff of The Campaign for Clemson were produced, including an invitation, programs, posters, banners, signage and promotional mailers. The invitation, designed by Jane Dom, won a CASE III Grand Award.

• The first annual report of Clemson research activities was produced and won a CASE III Merit Award.

• Clemson World magazine art director Dale Cochran won two Addy awards from the Greenville Ad Federation — a Silver Addy for the special Centennial issue and a Gold Addy for the Thomas Clemson illustration in that issue.

• The Clemson World magazine printing contract was rebid, and a $2,500 per issue savings over previous printing costs is being realized as a result.

• Studio Manager Eve Gibson won a University Relations mini-sabbatical. She visited a variety of design studios in the Chicago area to learn about advancements in desktop publishing.

• Editor Sandra Parker won third place in Alpha Kappa Alpha’s Emory O. Jackson regional journalism competition.

• P&G has completed its first year of using an in-house job tracking database, resulting in increased report flexibility and more complete and accurate expenditure records.

• Computer-aided design was enhanced with the acquisition of a Macintosh IICX and 19-inch color monitor.

Board of Visitors

One of the key volunteer groups that serves the University’s institutional advancement program is the Board of Visitors. Through this program, 40 prominent business leaders serve as advisers to the University, visit the campus for updates on programs and priorities, and help provide a two-way communications link between the University and the public in their respective communities.

This important advisory group to the administration was very active during the past year. One of the highlights was a tour of N.C. State University at Raleigh Sept. 28-30, 1989. The program gave the Board of Visitors an opportunity to hear about innovative research and public service programs and activities at a sister, land-grant university.

On March 13, 1990, the board hosted its fifth Governmental Appreciation Reception in Columbia for members of the South Carolina House and Senate. Exhibits from Clemson’s academic colleges were viewed by participants. The following month, on April 18-19, the Board of Visitors came to the Clemson campus for its annual spring meeting.

Members of the Board of Visitors are nominated by the Board of Trustees and appointed by the president. They are assigned to four working committees: academic affairs, legislative relations, media and research.
Historic Houses

During the past year the University committed to the historic conservation of its campus architectural resources by creating a new position and hiring the first director of historic houses. Through the historic houses, a public understanding of the origins of Clemson University within the rich heritage of the state and nation will be fostered. The houses will be interpreted by coordinating various University disciplines and nationwide historic preservation resources. Clemson experts in the fields of architecture, history, horticulture, tourism, archeology, languages, textiles and performing arts will have the opportunity to participate in the development of the historic houses as well as to use the buildings as interdisciplinary laboratories for students and the community. With a continued increase in visitor programs and activities at Clemson, the historic houses will become an even more important entity for communication within the University community.

Communications and External Relations

The mission of Communications and External Relations (CER) is to facilitate accurate, frequent, productive, and widespread communication with internal and external audiences of Clemson University and to promote the positive image of Clemson University.

The associate vice president of CER supervises the Office of Constituent Communications, which produces the Clemson World, Clemson World News, President's Letter and other internal newsletters, and the Office of News Services, which includes the director of news services and five news editors who act as contacts between the University and the working press.

Through the offices of Constituent Communications and News Services, CER provides advice to the president, vice presidents and Board of Trustees on media and external relations matters; works closely with University counsel on Freedom of Information Act matters; serves as communications liaison for Clemson University's efforts in Washington, D.C., and Columbia; serves as public relations counsel to each of Clemson University's nine colleges, the vice president for research and the Strom Thurmond Institute; and coordinates preparation of the president's annual report.

Constituent Communications

The role of the Constituent Communications program in institutional advancement is to help the University keep constituent audiences (primarily alumni, faculty, staff, donors and other supporters) informed about and involved in Clemson.

The major "products" of this effort are four periodical publications:

- Clemson World magazine (circulation 23,000),
- Clemson World News tabloid newspaper (circulation 85,000),
- Clemson Weekly faculty/staff newsletter (circulation 4,000), and
- The Campaign for Clemson Partnership Report (circulation 1,500 donors).
Staff members also provide editorial and communications counsel and support for special projects, such as the $62-million Campaign for Clemson. In FY 1989-90, the program:

- Completed phase III of a five-year plan to improve the periodicals by naming a photo editor, converting totally to desktop publishing, re-bidding the printing of *Clemson World* and launching an advertising support program. The latter three steps both saved money and increased resources available for the publications.
- Prepared and published four issues each of *Clemson World* and *Clemson World News*, including a special issue on private support (the “Honor Roll” issue).
- Prepared and published more than 40 issues of *Clemson Weekly* and companion “news specials” for the internal audience.
- Assisted the president, vice presidents and other administrators with special communications projects, as needed, including the *President's Report, President's Letter* (a biweekly newsletter) and other media.
- Provided leadership for communicating the public announcement of The Campaign for Clemson on Nov. 10, 1989. Arranged for and produced a special six-page section on the campaign in *The News* (Greenville) and a series of four advertisements in *The State* (Columbia); created and launched the *Partnership Report*.
- Handled the internal/constituent component of special communications efforts such as the mass measles immunization in February 1990; the resignation of the head football coach and his replacement, etc.
- Assisted Alumni Relations and the Development Office with special communications and newsletters for major donors and Clemson Club officers.

**News Services**

The Department of News Services provides the University with a means of communication to the public through the external news media. Staff members generate news and feature stories about the University’s education, public service and research programs for use by state, regional and national news media and in constituent publications, such as *Clemson World* magazine, *Clemson World News* tabloid and the faculty-staff newsletter. Services also include editing and marketing faculty-written columns and book reviews; coordinating coverage of campus events, speakers and Board of Trustees meetings; conducting news conferences and major public relations campaigns; advising University administrators on media relations issues; acting as liaisons between the University and the print and broadcast media; serving as spokesmen for the University to the news media; and providing media training for Clemson faculty, staff and administrators.

In 1989-90 News Services produced:

- 421 general news releases and announcements.
- 3,963 hometown news releases.
- 38 weekly media tip sheets.
- 54 Living Well columns.
• 49 Books for Children reviews.
• 6 Bright Ideas (special tip sheets).
• 8 editorials.
• 4 features packets (back to school, 11 releases; The 1990s, 18 releases; Rolling Stones, 7 releases; Travel, 10 releases).
• Daily executive news briefing.
• Daily "Clemson Daybook" tip sheet.
• Monthly calendar tip sheet.
• Public relations plans and arrangements for The Campaign for Clemson kickoff, Centennial wrap-up, measles inoculation program, NCAA investigation, and numerous research and major-gift announcements.

Alumni Relations

The Alumni Relations Office provides a variety of programs and services for Clemson alumni, friends, students and students' parents. The 1989-90 highlights are listed below:

Alumni Programs

This area is responsible for planning, directing and overseeing all campus-based, alumni-related programs and for working with special groups of alumni and students. In 1989-90:

• There were 100 Young Alumni events, ranging from TV viewing parties to harbor cruises. Among other accomplishments, the Young Alumni Associates recognized top high school students through the Thomas Green Clemson Award program, which recognizes a graduating senior who excels in academics, community service and as a student leader. Personalized plaques were awarded to 72 recipients. Also, Jane Robelot '82 was chosen Young Alumnus of the Year.
• A survey was conducted of 1,200 female graduates. Responses were used to put together a 17-member National Women's Council. The Women's Council's purpose is to design educational seminars for Clemson alumnae in several cities in South Carolina, Charlotte and Atlanta to maximize involvement of female graduates with Clemson.
• The Student Alumni Council hosted the Welcome Back Festival to start the academic year, co-sponsored Parents' Weekend, selected Dr. C. Kenyon Revis-Wagner, a professor of biology, as the 1990 Alumni Master Teacher, and sponsored the senior picnic with record attendance.
• The staff planned and produced Reunion Weekend '90 with more than 500 alumni and friends attending from 18 different reuniting classes.
• Special constituency meetings were held for the following groups: past Student Body Presidents, former Clemson Cheerleaders, Alumni Band, Clemson Alumni Physicians and Dentists, and Clemson Black Alumni.
• Parents’ Weekend attracted more than 5,000 people on October 6-8.
• Fifteen alumni college events were held throughout the year to involve alumni with the University and their particular college.
• Six monthly informational briefings were held to enhance staff’s knowledge of University programs/plans.
• The Alumni National Council developed and approved a five-year plan to govern the programmatic development of the University’s alumni program.

Field Activities
This area is responsible for planning, directing and overseeing off-campus, alumni-related programs, with particular emphasis on encouraging the development and growth of locally based Clemson Clubs throughout the state, region and nation.

In 1989-90:
• There were 62 Clemson Clubs meetings around the country. There are currently 25 chartered clubs (have a formal constitution, hold at least two meetings annually and have a basic mission to serve Clemson) as compared to 17 last year. During fall and spring Clemson Club meetings, more than 12,000 alumni and friends were served. High school receptions were hosted by 12 clubs.
• The Alumni Office coordinated the campaign kickoff event November 10-11 with eight Clemson Clubs in the region and 16 foreign locations participating.
• The third Clemson Club officers’ training weekend, Leadership Clemson, attracted more than 100 club leaders from around the country.
• Alumni Headquarters and related events were provided for the regular-season away football games, the Gator Bowl and the Atlantic Coast Conference basketball tournament. More than 2,000 alumni and friends were served.
• The Greenville Breakfast Club was initiated, with more than 70 business people attending this bimonthly meeting. Six meetings were held.

Special Events
This area assists all Institutional Advancement departments and other University divisions in planning and producing special events (on and off campus) to enhance Clemson’s image and to meet particular constituent or program needs.

In 1989-90:
• The Clemson Alumni Association and City of Clemson co-hosted a reception in August to welcome new faculty members to the campus and community.
• During the 1989 football season, the Office of Special Events coordinated all activities for the President’s Box.
• Special commencement luncheons were offered at the December and May graduations with good attendance.
• Organized the third annual Keowee Key Clemson Club trip to Charleston with 41 people participating.
• The tenth annual Clemson Medallion Dinner attended by 265 people was held in April honoring W. Green DesChamps and Milton Holcombe.

Marketing

In 1989-90:
• The number of Clemson University VISA and MasterCard credit cards held by Clemson alumni and friends increased by 30 percent, with revenue increasing steadily each month.
• A special group insurance program was offered to graduating seniors and alumni. Responses far exceeded expectations on the first offering.
• Five alumni travel programs were offered with 48 alumni participating. A Young Alumni ski trip attracted more than 90 young alumni.
• Merchandising offers included the Clemson watch and chairs, Alumni Association umbrella and special "Tiger Paw" athletic shoes.
• Work was successfully completed, making the Clemson license tag program a reality, passing the S.C. Legislature in June.
• Advertising sales brought $12,000 to the Clemson World and $7,000 to the Clemson World News.

Visitors Center

The Visitors Center served 19,558 people; conducted 458 regularly scheduled guided tours; arranged school and community tours for 189 groups; and arranged and guided 121 special group tours.

Development Office

The objectives of Clemson’s private support efforts are deliberate and broad-based. They encompass growth in the unrestricted permanent endowment, expansion of all phases of general and endowment support for faculty, increased sources of student financial aid and further development of the annual Loyalty Fund program, which enhances the total academic environment. While state appropriations are a part of the total support for the educational activities at Clemson, more than 50 percent of the total budget must come from other sources. In that context, the ultimate quality of the University rests with private support from business, industry, alumni and friends of the University.

In 1989-90:
• Private gifts for Clemson’s academic programs jumped 16.2 percent, reaching $14.6 million and crossing into double digits for the third time in history.
• Unrestricted giving to the annual Clemson Loyalty Fund reached $1.2 million.
• 15,561 individuals made annual gifts to current operations. The average of these gifts was $361.
• Of Clemson’s alumni on record, 24.9 percent — twice the national average for state-assisted schools — participated in the Loyalty Fund.
• New gifts totaling $.7 million were received from 1,923 donors who had never given before.

• Of the $14.6 million total, $6.3 million came from individuals, $8.3 million from corporations, foundations and trusts.

• A total of 19,114 gifts — including gifts for annual operations and for capital purposes, from individuals and from organizations — were received in 1989-90. The average gift from all sources was $762, up 30 percent from last year.

• Total expenditures relative to year-end fund-raising results indicate a cost of 12.62 cents to raise each dollar.

The year was highlighted by several large contributions from both individuals, corporations and foundations.

**Advancement Services**

The Office of Advancement Services, created in 1987, provides support for all Institutional Advancement offices. Primary functions of its gift management area include: gift receiving, gift processing and endowment management. Functions of the information management office include donor research and database management for the development, alumni and media databases. It also was charged with the responsibility for maintaining the alumni and development data systems.

In 1987-88, most activity in Advancement Services centered around staff recruitment and training, systems analysis and program upgrading, the development of financial policies and procedures, and the introduction of systematic financial analysis. In 1988-89, activity continued in those areas.

The year also saw the organization of personnel into two units. The director of donor research was given the additional responsibility for all database services and systems maintenance as well as the Research Office. This group concerns itself primarily with non-financial, biographical data. The gift-processing and financial-management functions were organized under the director of accounting services.

Two additional areas — financial analysis and planning and management of the Foundation’s $33 million endowment — were important priorities for the year as well.

• The Office of Donor Research developed a reference library in which published references are complemented by on-line databases and other research tools. Comprehensive profiles of prospective donors have been developed and maintained accordingly.

• Data-entry protocols and controls have been introduced; data programs were substantially rewritten; and preparations and controls are being made for a comprehensive alumni survey scheduled for fall 1991. The Accounting Services group made further improvement in meeting tighter standards for daily gift processing and reporting. Additional financial controls were introduced. Regular reporting on operating and endowment accounts was begun.
• Analysis was conducted on data-processing and gift-processing efficiency. An experiment with machine-read barcoding has been completed. Plans are being made for the broad application of barcoding in the next year.

• Additional analysis has been conducted on the cost of raising funds for the Development Office.

STUDENT AFFAIRS

The 1989-90 academic year marked the highest (total) University enrollment, with 16,072 students registered for classes — 13,413 full time and 2,659 part time. This represents an increase of over 8 percent from last year. Of the total enrollment, 3,509 were graduate students.

The College of Commerce and Industry had the highest collegiate enrollment with 3,860 students. The College of Engineering was second with 3,672, followed in order by Education (2,617), Sciences (1,676), Liberal Arts (1,672), Agricultural Sciences (794), Architecture (726), Forest and Recreation Resources (509) and Nursing (380).

Higher education continued to become increasingly accessible as evidenced by the number of freshmen entering college with advanced standing. In the 1989-90 fall semester, new high school graduates entered Clemson with advanced standing by means of College Board Advanced Placement courses (1,125 students, 7,151 credit hours) and by concurrent enrollment in high school and college or enrollment in summer school (172 students, 913 credit hours).

At Clemson, performance in high school has proven to be the best single predictor of success in the freshman year. The class ranks of entering freshmen improved somewhat, with 34.5 percent of the class entering in fall 1989 ranked in the top 10 percent of their class, 60 percent in the top 20 percent and 94 percent in the top 50 percent. The freshman class average Scholastic Achievement Test (SAT) score of 1,025 compared with an average of 903 reported by the College Board for all high school seniors. It is also the highest average among state-supported institutions in South Carolina. Of the 9,786 new applications for admission processed for 1989-90, 6,337 were accepted, and 3,525 actually enrolled (including freshmen and transfer students).

Clemson students come from all 46 South Carolina counties, 48 states, Puerto Rico, the District of Columbia and 67 foreign countries. South Carolina residents accounted for 68 percent of the 16,072 students. Greenville County continued to have the most students enrolled (1,737). Pickens County was second with 1,154, followed in order by Anderson, Oconee, Spartanburg and Charleston counties. Most out-of-state students came from Georgia (553), Florida (472) and North Carolina (443).

Computerized pre-registration helped the record number of students get off to a smooth start for fall classes. Approximately 86 percent were pre-registered and had their course schedules completed before they arrived on campus to begin classes.
### Fall Semester Enrollment Comparisons for Recent Years

<table>
<thead>
<tr>
<th>Year</th>
<th>Undergraduate</th>
<th>Graduate and Others</th>
<th>Total</th>
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<tr>
<td>1972-73</td>
<td>7,686</td>
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<tr>
<td>1973-74</td>
<td>7,910</td>
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<td>1974-75</td>
<td>8,171</td>
<td>2,415</td>
<td>10,586</td>
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<td>1975-76</td>
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<td>1977-78</td>
<td>8,708</td>
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<td>1978-79</td>
<td>8,925</td>
<td>2,553</td>
<td>11,478</td>
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<tr>
<td>1979-80</td>
<td>9,291</td>
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<td>1981-82</td>
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<td>1988-89</td>
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<tr>
<td>1989-90</td>
<td>12,563</td>
<td>3,509</td>
<td>16,072</td>
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The enrollment of women at Clemson reached an all-time high during the 1989 fall semester. There were 7,113, of which 5,404 were undergraduates. Enrollment of undergraduate women increased more than 6 percent from last year, and women now constitute approximately 43 percent of the undergraduate enrollment.

The Clemson student body continues to be a working group, receiving a significant amount of financial assistance through loans, grants, scholarships and employment. Clemson awarded 676 long-term loans totaling $914,725. The University also approved and certified 2,523 guaranteed student loans with a total value of $5,749,717 from a variety of lending institutions. Excluding donor-selected scholarships, 2,127 scholarships and grants valued at $3,886,356 were awarded. The number of students receiving Pell Grants was 1,800, with awards totaling $2,614,323. In all, about 68 percent of the student body received an estimated total of $21 million in financial assistance.

Student organizations continued to offer popular opportunities for student involvement, with more than 245 recognized student groups providing a variety of experiences to members. The student media and student government each experienced growth years in terms of student interest and participation.

Clemson's 12 women's and 16 men's fraternal organizations remained a popular choice for student involvement, claiming approximately 20 percent of the undergraduate population as members. Both the Interfraternity Council (IFC) and the Panhellenic Council total membership earned an overall grade point ratio in excess of the respective undergraduate male and female GPRs for all students for both semesters. The IFC committed to expansion in the fall 1990 (Lambda Chi Alpha), and Panhellenic is aiming toward a fall 1991 expansion.
Several successful programs emanated from the Student Development Office, including Black Male and Black Female Emphasis Weeks, several Black History Month programs and the Black Students of Promise dinner. The spring semester saw the Clemson Leadership Awareness Seminars for Students (C.L.A.S.S.) program initially offer more than 25 seminars taught by both University and non-affiliated presenters on a wide variety of leadership development topics. More than 140 students participated in this pilot program. The spring semester also saw Student Development take the lead in revising alcohol regulations and developing and implementing a more comprehensive social policy.

The Career Center provided record numbers of students with assistance in career planning and in their search for full-time jobs or summer internships. The renovation project, which added eight new interview rooms, was completed in the fall. Industry donations to help fund this project amounted to $53,500. The Career Center initiated a new policy this year of offering their services to alumni for a nominal fee.

The Counseling Center underwent some important changes in 1989-90. The career planning function of the center was moved to the Career Center. This allowed students more access to career information from the beginning to the end of their planning processes. Additionally, the services at the Counseling Center could be more tightly focused on the personal and developmental needs of the students. New staff were hired, procedures related to counseling issues were intensified, and the center took on a full-service status for Clemson students.

The 1989 academic year was truly a banner year for the Clemson University Union. The Union continued to excel in providing a learning experience in which students developed their organizational, communication and leadership skills. The University Union recruited and trained more than 250 student leaders this past year. These volunteers presented 744 programs with a combined attendance of more than 119,000 people in 1989.

This year’s highlights included the most spectacular entertainment event in the history of South Carolina when the Rolling Stones “Steel Wheels Tour” made a stop in Death Valley. The Cultural Arts Committee was thrilled to present two incredible performances by George Winston. The emergence of the Third World Student Programming Alliance as true campus leaders was especially exciting. Rounding out the year was another outstanding line-up of films presented by the Films and Video Committee.

Clemson was the only school in the nation that won a bowl game, an NCAA tournament basketball game and an NCAA tournament baseball game in the 1989-90 year. It marked the second straight year Clemson had pulled off this triple. Both of Clemson’s basketball teams advanced to the Sweet 16 of their respective NCAA tournaments. Both basketball teams boasted the ACC Coach of the Year as did the indoor and outdoor track coach. Former head football coach Frank Howard was inducted in the National Football Foundation Hall of Fame during ceremonies in New York City in December 1989.
### Number and Percent of Black Students

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<th>Year</th>
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<th>Percent</th>
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<td>1984</td>
<td>528</td>
<td>4</td>
</tr>
<tr>
<td>1985</td>
<td>671</td>
<td>5</td>
</tr>
<tr>
<td>1986</td>
<td>714</td>
<td>5.47</td>
</tr>
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<td>1987</td>
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<td>5</td>
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<td>1988</td>
<td>789</td>
<td>5.3</td>
</tr>
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<td>1989</td>
<td>1,004</td>
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### Average College Board of Freshmen

<table>
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<tr>
<th>Year</th>
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<tr>
<td>1972</td>
<td>995</td>
</tr>
<tr>
<td>1973</td>
<td>982</td>
</tr>
<tr>
<td>1974</td>
<td>984</td>
</tr>
<tr>
<td>1975</td>
<td>983</td>
</tr>
<tr>
<td>1976</td>
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<tr>
<td>1978</td>
<td>1,000</td>
</tr>
<tr>
<td>1979</td>
<td>1,002</td>
</tr>
<tr>
<td>1980</td>
<td>1,005</td>
</tr>
<tr>
<td>1981</td>
<td>1,007</td>
</tr>
<tr>
<td>1982</td>
<td>1,017</td>
</tr>
<tr>
<td>1983</td>
<td>1,014</td>
</tr>
<tr>
<td>1984</td>
<td>1,012</td>
</tr>
<tr>
<td>1985</td>
<td>1,012</td>
</tr>
<tr>
<td>1986</td>
<td>1,025</td>
</tr>
<tr>
<td>1987</td>
<td>1,028</td>
</tr>
<tr>
<td>1988</td>
<td>1,032</td>
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<tr>
<td>1989</td>
<td>1,025</td>
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### Student Faculty Ratio (Full-Time Equivalent)

<table>
<thead>
<tr>
<th>Year</th>
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<td>1972</td>
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<tr>
<td>1973</td>
<td>16.8:1</td>
</tr>
<tr>
<td>1974</td>
<td>17.9:1</td>
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<tr>
<td>1975</td>
<td>18.3:1</td>
</tr>
<tr>
<td>1976</td>
<td>17.6:1</td>
</tr>
<tr>
<td>1977</td>
<td>16.3:1</td>
</tr>
<tr>
<td>1978</td>
<td>15.9:1</td>
</tr>
<tr>
<td>1979</td>
<td>16.0:1</td>
</tr>
<tr>
<td>1980</td>
<td>15.6:1</td>
</tr>
<tr>
<td>1981</td>
<td>16.4:1</td>
</tr>
<tr>
<td>1982</td>
<td>16.6:1</td>
</tr>
<tr>
<td>1983</td>
<td>17.0:1</td>
</tr>
<tr>
<td>1984</td>
<td>16.1:1</td>
</tr>
<tr>
<td>1985</td>
<td>15.4:1</td>
</tr>
<tr>
<td>1986</td>
<td>16.9:1</td>
</tr>
<tr>
<td>1987</td>
<td>18.3:1</td>
</tr>
<tr>
<td>1988</td>
<td>18.9:1</td>
</tr>
<tr>
<td>1989</td>
<td>19.7:1</td>
</tr>
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</table>

### Number in Freshmen Class (New Students)

<table>
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<tr>
<th>Year</th>
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</tr>
</thead>
<tbody>
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<td>1972</td>
<td>1,919</td>
</tr>
<tr>
<td>1973</td>
<td>2,034</td>
</tr>
<tr>
<td>1974</td>
<td>1,949</td>
</tr>
<tr>
<td>1975</td>
<td>1,901</td>
</tr>
<tr>
<td>1976</td>
<td>1,861</td>
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<tr>
<td>1977</td>
<td>1,838</td>
</tr>
<tr>
<td>1978</td>
<td>2,020</td>
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<td>1979</td>
<td>1,998</td>
</tr>
<tr>
<td>1980</td>
<td>2,008</td>
</tr>
<tr>
<td>1981</td>
<td>2,284</td>
</tr>
<tr>
<td>1982</td>
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<td>1984</td>
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<tr>
<td>1985</td>
<td>2,259</td>
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<td>1986</td>
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<td>1988</td>
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<td>2,900</td>
</tr>
<tr>
<td>Year</td>
<td>Teachers</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>1972</td>
<td>614.9</td>
</tr>
<tr>
<td>1973</td>
<td>578.4</td>
</tr>
<tr>
<td>1974</td>
<td>591.8</td>
</tr>
<tr>
<td>1975</td>
<td>602.5</td>
</tr>
<tr>
<td>1976</td>
<td>611.3</td>
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<td>1977</td>
<td>654.4</td>
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<tr>
<td>1978</td>
<td>675.6</td>
</tr>
<tr>
<td>1979</td>
<td>691.8</td>
</tr>
<tr>
<td>1980</td>
<td>718.2</td>
</tr>
<tr>
<td>1981</td>
<td>709.7</td>
</tr>
<tr>
<td>1982</td>
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<td>1983</td>
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<tr>
<td>1984</td>
<td>762.5</td>
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<tr>
<td>1985</td>
<td>797.3</td>
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<td>1986</td>
<td>731.24</td>
</tr>
<tr>
<td>1987</td>
<td>713.93</td>
</tr>
<tr>
<td>1988</td>
<td>755.48</td>
</tr>
<tr>
<td>1989</td>
<td>769.33</td>
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* Includes beds in the Clemson House.

Number of On-Campus Students in Summer School

<table>
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<th>Year</th>
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<tr>
<td>1973</td>
<td>6,267</td>
</tr>
<tr>
<td>1974</td>
<td>5,997</td>
</tr>
<tr>
<td>1975</td>
<td>6,275</td>
</tr>
<tr>
<td>1976</td>
<td>6,100</td>
</tr>
<tr>
<td>1977</td>
<td>6,301</td>
</tr>
<tr>
<td>1978</td>
<td>6,393</td>
</tr>
<tr>
<td>1979</td>
<td>6,708</td>
</tr>
<tr>
<td>1980</td>
<td>6,858</td>
</tr>
<tr>
<td>1981</td>
<td>6,897</td>
</tr>
<tr>
<td>1982</td>
<td>7,149</td>
</tr>
<tr>
<td>1983</td>
<td>7,442</td>
</tr>
<tr>
<td>1984</td>
<td>7,418</td>
</tr>
<tr>
<td>1985</td>
<td>8,126</td>
</tr>
<tr>
<td>1986</td>
<td>8,562</td>
</tr>
<tr>
<td>1987</td>
<td>8,446</td>
</tr>
<tr>
<td>1988</td>
<td>8,689</td>
</tr>
<tr>
<td>1989</td>
<td>9,039</td>
</tr>
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</table>
### Fall Semester 1988 Enrollment by Colleges and Degrees Awarded

#### December 1988-August 1989

<table>
<thead>
<tr>
<th>College / Sciences</th>
<th>Total Enrollment</th>
<th>Fall Semester</th>
<th>Associate</th>
<th>Bachelor's</th>
<th>Master's</th>
<th>Specialist</th>
<th>Doctorates</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Sciences</td>
<td>794</td>
<td>0</td>
<td>84</td>
<td>45</td>
<td>0</td>
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<td></td>
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<td>86</td>
<td>60</td>
<td>0</td>
<td>0</td>
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<td>146</td>
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<td>Commerce and Industry</td>
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<td>703</td>
<td>99</td>
<td>0</td>
<td>9</td>
<td></td>
<td>811</td>
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<tr>
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<td>157</td>
<td>0</td>
<td>21</td>
<td></td>
<td>638</td>
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<tr>
<td>Forest and Recreation Resources</td>
<td>509</td>
<td>0</td>
<td>125</td>
<td>18</td>
<td>0</td>
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<td>5</td>
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<td>69</td>
<td>0</td>
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<td>287</td>
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<td>Non-Degree</td>
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<td></td>
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<td></td>
<td>287</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>16,072</strong></td>
<td><strong>0</strong></td>
<td><strong>2,180</strong></td>
<td><strong>636</strong></td>
<td><strong>4</strong></td>
<td><strong>80</strong></td>
<td><strong>0</strong></td>
<td><strong>2,900</strong></td>
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</table>

Degrees awarded since 1896 (through August 1989) total 68,193 of which 426 have been associate degrees; 54,414 bachelor's degrees; 12,147 master's degrees; 152 education specialist degrees; and 1,054 doctorates. Includes 582 Clemson-Furman MBA degrees awarded May 1972-August 1989.
<table>
<thead>
<tr>
<th>Sport</th>
<th>Home</th>
<th>Away</th>
<th>Neutral</th>
<th>ACC</th>
<th>Overall</th>
<th>Pct.</th>
<th>ACC Regular Finish</th>
<th>ACC Trn.</th>
<th>National Rank</th>
<th>1st Team All-ACC</th>
<th>All American</th>
</tr>
</thead>
<tbody>
<tr>
<td>Football</td>
<td>5-1</td>
<td>4-1</td>
<td>1-0</td>
<td>5-2</td>
<td>10-2</td>
<td>.833</td>
<td>3rd</td>
<td>—</td>
<td>12th</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Soccer</td>
<td>12-2</td>
<td>1-3-1</td>
<td>0-1</td>
<td>1-4-1</td>
<td>13-6-1</td>
<td>.675</td>
<td>15th</td>
<td>T5</td>
<td>—</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Women's Cross Country</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>NA</td>
<td>2nd</td>
<td>7th</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Men's Cross Country</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>NA</td>
<td>2nd</td>
<td>21st</td>
<td>5</td>
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</tr>
<tr>
<td>Volleyball</td>
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<td>6-1</td>
<td>4-2</td>
<td>30-7</td>
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<td>T5</td>
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<td>Women's Basketball</td>
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<td>7-4</td>
<td>3-2</td>
<td>10-4</td>
<td>22-10</td>
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<td>T3rd</td>
<td>19th</td>
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<td>10-4</td>
<td>26-9</td>
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<td>1st</td>
<td>T3rd</td>
<td>17th</td>
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<td>10-6</td>
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<td>29th</td>
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<tr>
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<td>1-0</td>
<td>3-2</td>
<td>6-3</td>
<td>.667</td>
<td>3rd</td>
<td>3rd</td>
<td>23rd</td>
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<tr>
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<td>.556</td>
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<tr>
<td>Women's Indoor Track</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>NA</td>
<td>2nd</td>
<td>41st</td>
<td>3</td>
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</tr>
<tr>
<td>*Men's Indoor Track</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>NA</td>
<td>1st</td>
<td>23rd</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Baseball</td>
<td>26-5</td>
<td>11-12</td>
<td>6-6</td>
<td>14-6</td>
<td>43-23</td>
<td>.652</td>
<td>2nd</td>
<td>3rd</td>
<td>30th</td>
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<td>1</td>
</tr>
<tr>
<td>Women's Tennis</td>
<td>6-2</td>
<td>7-5</td>
<td>2-2</td>
<td>1-1</td>
<td>15-9</td>
<td>.625</td>
<td>2nd</td>
<td>2nd</td>
<td>21st</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Men's Tennis</td>
<td>3-4</td>
<td>5-4</td>
<td>8-10</td>
<td>6-1</td>
<td>16-18</td>
<td>.471</td>
<td>1st</td>
<td>2nd</td>
<td>—</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Women's Outdoor Track</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>NA</td>
<td>3rd</td>
<td>33rd</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>*Men's Outdoor Track</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>NA</td>
<td>1st</td>
<td>46th</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>*Golf</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>NA</td>
<td>T1st</td>
<td>—</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>Overall Totals</td>
<td>105-20-0</td>
<td>57-51-1</td>
<td>34-26</td>
<td>65-31-1</td>
<td>196-97-1</td>
<td>.668</td>
<td>2 Firsts</td>
<td>3 Firsts</td>
<td>8 Top 25</td>
<td>82</td>
<td>17</td>
</tr>
</tbody>
</table>

*Indicates ACC Champion
UNIVERSITY RESEARCH

During this past fiscal year, Clemson enhanced its reputation as one of the nation’s premier research universities with gifts, grants and contracts awarded totaling more than $28 million (a 22 percent increase over the previous year). Expenditures specifically organized to produce research outcomes during this period of continued growth exceeded $50 million, and total research expenditures, including sponsored programs, totaled more than $75 million.

Clemson is ranked by the National Science Foundation as being among the top 100 institutions in total research and development expenditures. The annual expenditures of these institutions in science and engineering are in excess of $12 billion.

Clemson University provides unusual flexibility and opportunity to sponsors to leverage their research objectives by utilizing a vast array of research organizations. The University’s commitment to strengthen public and private research has historically built excellent internal as well as external partnerships to achieve research objectives. The institutional linkage of University research activities extends across the boundaries of all the academic colleges, institutes and centers to provide an effective foundation for collaboration and partnerships with government and industrial sectors.

The scholarship activities performed by faculty and administrators at Clemson University significantly contribute to the environment and knowledge required to solve universal problems. During this past fiscal year, the Office of University Research processed more than 1,000 research proposals, grants and awards submitted by faculty members, departments, colleges and other administrative units. The specific awards and their associated activities were as follows:

- Dr. David N. S. Hon, professor of forestry, was the recipient of the Alumni Award for his efforts in wood chemistry. Dr. Hon received a $1,500 stipend from the Alumni Association and was recognized at the May 1990 commencement.
- Twenty-five Provost Awards were made in the amount of $2,000 each. The purpose of the Provost Awards is to stimulate research activities by Clemson University faculty.
- Three Biomedical Research Support Grants were made for a total of $9,023. These are funds made available from the National Institute of Health (NIH) based on the total support given to Clemson by that agency.
- More than 70 applications were submitted to the University Research Grant Committee for review, and awards ranged from a minimum of $1,000 to a maximum of $3,000. Eleven of these awards were funded for a total allocation of $31,205.

In addition to these internally funded research awards, $75,000 was set aside in 1989-90 for faculty initiatives submitted for funding consideration by the Innovative Fund Committee. Six ideas from four colleges were funded as part of this program. More than $738,000 also was distributed to faculty members for 1989–90 Cutting Edge projects in the second year of an intensified effort by the state to fund research having an economic impact in South Carolina.
A new department (Research Services) was established in 1989 to (1) coordinate institutional compliance with federal laws regulating the use of animals in research teaching and testing activities, human subjects research and NIH Safety Guidelines, and (2) provide professional and technical support for activities involving animals used in research, teaching and testing. Accomplishments for the Research Services Office included the following:

- In July 1989 the institution appointed a campuswide Biosafety Committee to review all research proposals involving recombinant DNA, biological, chemical and radioactive hazards, in accordance with new federal guidelines.
- Program planning for new agriculture and biomedical research and teaching facilities was initiated in January 1989 and is now nearing completion.
- A comprehensive institutional policy to respond to public inquiries regarding use of animals was developed. In the past year, numerous research facilities on college campuses across the country have been vandalized or destroyed by animal activists.

In 1989 an Emerging Technology Center (ETC) was established at Clemson University to stimulate and improve economic development in South Carolina. A unique alliance was formed between Clemson University and Battelle Memorial Institute to manage, develop and transfer technology to government and industrial sectors. Major accomplishments of this center are listed below.

- Several cooperative federal R & D projects were initiated, such as environmental toxicology, advanced materials, packaging, training, energy systems, medical and health care products and manufacturing processes.
- A Battelle two-year fellowship was established at Clemson to support environmental toxicology research.
- Sponsorship was provided for the Second Southeast Capital Connection Conference, a venture capital conference for South Carolina. The conference was attended by more than 150 venture capitalists, entrepreneurs and small businesses. To date, four of these businesses have received financial support to expand their manufacturing capabilities. The center also sponsored the First Inventor’s Fair in cooperation with the state’s Expo ’89. Sixteen inventors exhibited at this exposition.
- Battelle and Clemson University co-sponsored a booth at the Automated Manufacturing ’90 (AM90) Southeast conference.

The Research Office participated in the recently established Clemson Minority Intern Program. Three individuals were selected for participation in the program, two from the Business and Finance area and one from agriculture.

The Patent Committee reviewed 17 patent disclosures and recommended to the University that nine of these be reviewed by patent counsel or a technology development corporation for both patentability and commercial possibilities. Discussions are under way relative to licensing of seven Clemson patents, and approximately $1 million in royalty income was received this past year.